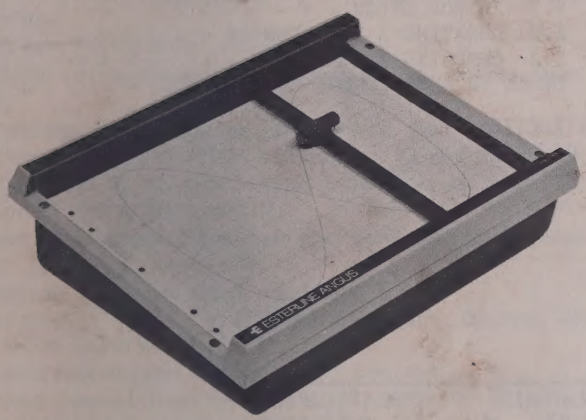
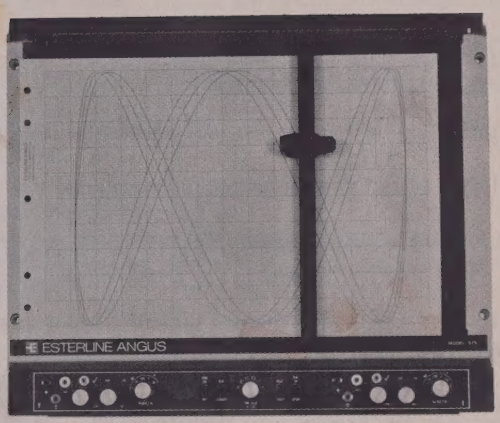
INSTRUCTION MANUAL FOR Esterline Angus Spartan X-Y recorder



XY575-BASIC (OEM)



XY575-LAB

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FOR A COMPLETE TECHNICAL DESCRIPTION OF YOUR SPECIFIC INSTRUMENT, SEE THE DATA SHEET WHICH IS SUPPLIED WITH THIS MANUAL. SPECIAL DRAWINGS AND SUPPLEMENTARY INSTRUCTIONS THAT MAY BE REQUIRED FOR YOUR RECORDER WILL BE LISTED ON THE DATA SHEET AND WILL ACCOMPANY THIS MANUAL.

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BASIC INSTRUMENT SPECIFICATIONS

NOTE: For LAB instrument specifications, refer to SECTION 6 of manual.

Acceleration: 1500 in/sec/sec, nominal (38 m/sec/sec), both axes.
Accuracy: ±0.25% of full scale.
Common mode rejection: 130 dB at DC.
Common mode voltages: 200 VDC to ground and between channels.
Deadband: ±0.1% of full scale.
Feedback potentiometer: Conductive plastic, infinite resolution.
Input configuration: Floating, single ended.
Input impedance: Essentially infinite on 1, 10, and 100 mV/in or 0.5, 5, and 50 mV/cm ranges; 1 megohm on 1 and 10 V/in or 0.5 and 5 V/cm ranges.
Internal adjustments: Servo gain, damping and variable sensitivity controls on each axis.
Overshoot: 1% of full scale, maximum.
Paper size: 11″ H x 17″ W (279 mm x 432 mm). Optional A3 size is 300 mm H x 420 mm W.
Pen drop repeat rate: 45 cycles/sec, nominal.
Pen drop control: Rear terminal strip connection (external switch supplied by customer).
Power requirements: 115 V or 230 V ±10%, 60 Hz, standard, 48-62 Hz rating is optional.
Repeatability: ±0.1% of full scale.
Standard sensitivities: 1 mV/in, 10 mV/in, 100 mV/in, 1V/in 10 V/in, or 0.5 mV/cm, 5 mV/cm, 50 mV/cm, 0.5 V/cm and 5V/cm. Variable sensitivity. +10%, 0% of basic range.
Signal input connections: Rear terminal strip, standard.
Size: 19″ x 14″ x 6″ (482 mm x 356 mm x 152 mm).
Slewing speed: 45 in/sec (1143 mm/sec) or faster.
Step response: 0.3 sec for 10 in (250 mm), both axes.
Temperature range (ambient) for rated specifications: 23° ±5°C.
Temperature range (operating): 10° to 40°C.
Weight: 14 lbs (6.4 kg).
Zero control: Customer supplied external potentiometer or internal 10 turn potentiometer, accessible from rear.
Zero offset: ±100% of full scale.

OPTION SPECIFICATIONS:

Event marker input: External switch or DC voltage causes pen deflection. Both X and Y axes available.
Deflection = 0.1 in/5 VDC. Input impedance = 1 megohm, minimum. Internal 15 VDC supply for external switch operation.
Power cord: 6 ft (1.8 m) three-wire cord with strain-relief hardware.
Power rating (universal): Provides for 115 or 230 V (±10%) and 48 to 62 Hz power sources.
Retransmitting potentiometer (either axis): Conductive plastic, 5000 ohms ±10%. 10 VDC max excitation, 1 mA max wiper current.
Remote quick-disconnector for: Pen up/down, zero control pots, event marker, signal inputs, sweep start and reset, retransmitting potentiometer(s).
Time base: Plug-in card with .01, .05, 0.1, 0.5, 1.0 and 2.0 in/sec, or .2, 1, 2, 10, 20, and 40 mm/sec. Time base accuracy. ±2% over operating range.
TTL logic inputs control functions: Provides 5 VDC TTL level control of pen drop and sweep control, as applicable.
Grid mask: Provides optimum vacuum hold-down for 8½″ x 11″ (215mm x 279mm) paper, when installed over vacuum grid.

Accessories (standard):
One package of six ink cartridges, one package of 100 sheets of graph paper, one operating and maintenance manual.

Accessory kit (optional): Includes one package of six red ink cartridges, one recorder dust cover, and two signal input cables with plug terminals.

SECTION 1— DESCRIPTION

1.1 INTRODUCTION

a. This instruction manual describes the basic X-Y graphic recorder offered in the Esterline Angus SPARTAN instrument line. These instructions include a general description, installation, operating procedures, wiring diagrams, and a complete replacement parts list for the Model XY-575 Recorder.

> NOTE: For information which is specific to the Model XY575-LAB recorder only, refer to SECTION 6 of manual.

b. Do not attempt to operate the instrument until you have thoroughly acquainted yourself with its features and operating techniques. Failure to follow recommended procedures may result in unsatisfactory operation or in damage to vital parts of the instrument.

c. Separate instructions or drawings supplied with this manual may contain information on optional accessories and attachments, or additional documentation that is required for special customized modifications.

> NOTE: If supplemental documentation conflicts with statements in this basic manual, the supplemental data shall be considered authoritative.

d. For a complete detailed description of your particular recorder, refer to the Data Sheet originally supplied with the instrument.

1.2 GENERAL DESCRIPTION

a. *SPARTAN* X-Y Recorders are precision general-purpose instruments designed to plot Cartesian coordinate graphs through the use of independent horizontal (X-axis) and vertical (Y-axis) internal measuring systems. The relationship between two analog

functions (represented by DC or low-frequency AC voltages) may be measured and graphically recorded on all models. In addition, models equipped with the internal time base option can also plot any Y-axis function in relationship to a known time rate on the X-axis.

b. The instrument employs an entirely new design concept in its Y-axis shuttle assembly. This *"Uniglide"* module contains not only a snap-in disposable ink cartridge but also an electrical pen-drop solenoid. Drive positioning cables carry controlling power to the solenoid so that the recording pen tip can be lowered and lifted rapidly by the operator. This capability makes possible combinations of solid and broken line traces. Another design feature is the illuminated graticules that are used to align the graph grid rather than the edge of X-Y paper.

c. Model XY-575 Recorders are available in either English (inch) or Metric (centimeter) calibrations. The basic instrument is without front-panel controls, but provides either internal connection terminals or an optional remote connector for all operating functions. This simplicity feature increases the versatility of the instrument when it is to be interfaced with other equipment.

NOTE: Refer to SECTION 6 for a description of the Control Module used in the Model XY575-LAB recorder.

1.3 PRINCIPLES OF OPERATION

a. The instrument is designed to simultaneously measure and record two independent variables by electro-mechanical positioning of a single inking pen on calibrated graph paper. Vertical disposition of the recording pen is controlled by the instruments Y-axis system, while the pen is positioned horizontally by the X-axis system.

Since the functional components of each system are basically the same, the following discussion will be limited to only one recording axis.

b. A basic system configuration is illustrated in the block diagram of Figure 1-1. Although the overall system operates on a null-balance principle, its functional stages may be divided into two major sections: (1) the input signal-conditioning circuits--which include preamplification, range components, and zero adjustment; and (2) the servo measurement loop--which includes servo signal amplification, a DC balance motor, and a feedback network.

NOTE: For block diagram of LAB recorder, refer to Figure 6-2 in SECTION 6 of manual.

1.3.1 Signal Conditioning Circuits

a. As shown in Figure 1-1, the input signal voltage is first applied to an R-C rejection filter to reduce power line pickup. The signal is then passed on to range determining preamp stage IC1. Here, the input signal is amplified and resistor R_R is chosen for the desired range of sensitivity. Although direct signal coupling is used on all MV input sensitivities, additional divider resistors are required for voltage input ranges. Span Adjust R3 is used to trim the selected range accuracy.

b. Preamplified signal voltage e_S is next coupled to one input section of differential amplifier IC2. The other input section of this stage receives an offset potential E_o. This voltage is established by manual adjustment of 10-turn Zero pot R_Z. The zero control is used to position the recording pen at the zero reference point on the graph paper, or to elevate or suppress zero as much as 100% of the graphic scale. Stability is maintained in the offset circuitry through the use of fixed bias voltages from the regulated reference supply.

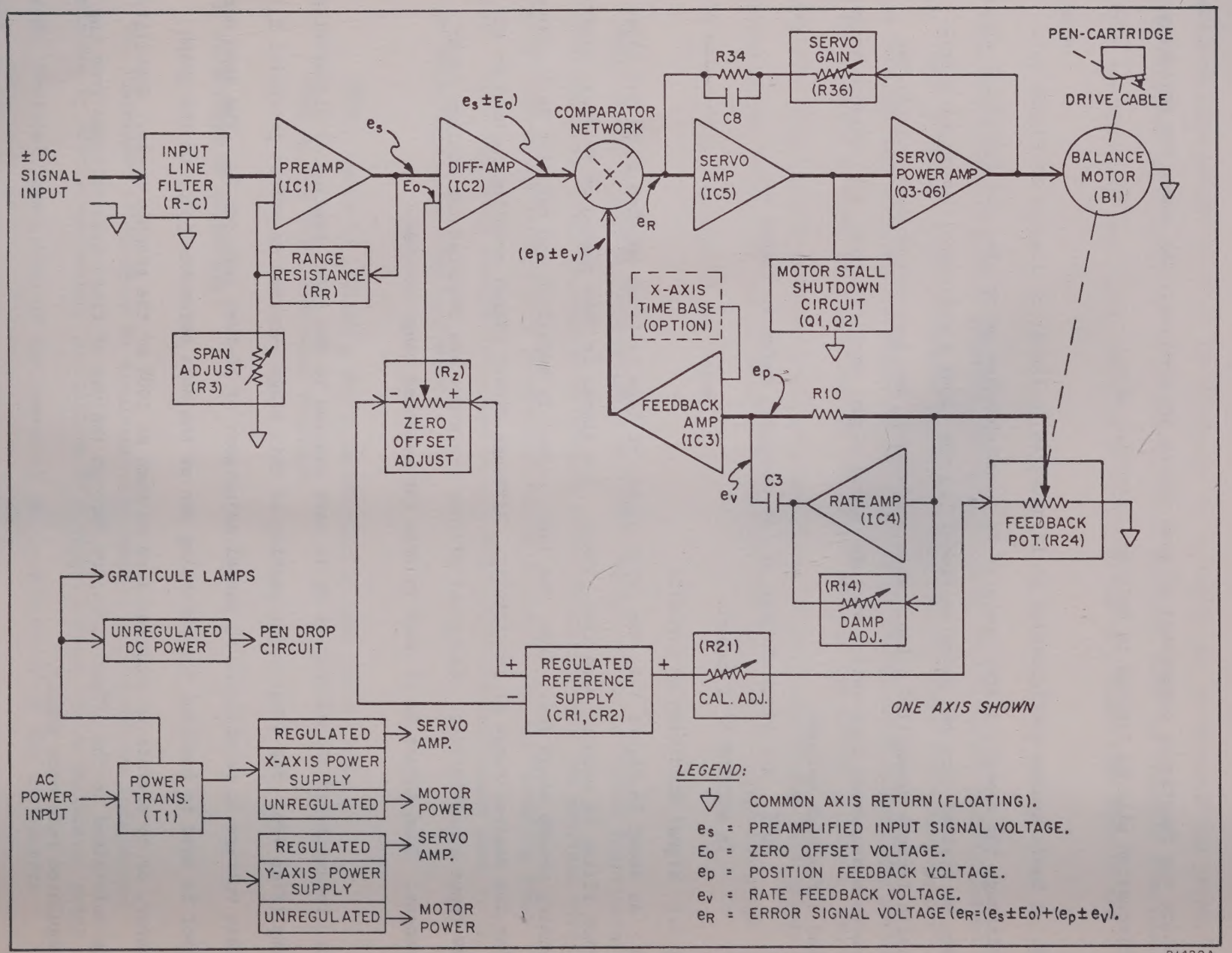


Figure 1-1. Simplified Block Diagram of Basic Recorder.

c. Signal voltage e_S and zero offset voltage E_O are algebraically summed at IC2. The differential output is then applied to a comparator network along with feedback signal e_P through resistor R10. Voltage e_P is directly proportional to the arm position of feedback pot R24 (equivalent to axis pen position). The two signals are compared in this network and, under "off-null" conditions, they will be unequal; consequently, an error signal voltage e_R will develop across the input of amplifier IC5.

1.3.2 Servo System

a. In the basic servo-measurement loop, the error signal is first amplified by IC5 and is then fed to the servo power amplifier. This circuit consists of signal inverter transistors Q3 and Q4 as well as output driver transistors Q5 and Q6. Gain adjust R36 regulates the overall amplification of the servo loop, while resistor R34 and capacitor C8 limit bandwidth of the amplifiers to reduce noise response.

b. Drive current from the power amplifier is delivered to balance motor B1 until the arm of the feedback pot reaches a voltage value directly proportional to the magnitude of the conditioned input signal. At this point the system is balanced, and the recording pen will come to rest at a new position on the graph axis. Signal polarity and amplitude determine the direction and speed of motor rotation.

c. The servo feedback system includes a dynamic damping circuit which is automatically regulated by velocity of the balance motor. The motor velocity signal is obtained from the arm of the feedback pot where it is introduced to rate amplifier IC4. Damp Adjust R14 varies the gain of this stage so that the operator can set the amount of rate feedback required for optimum servo response. From IC4, the rate signal is coupled through capacitor C3 and is then algebraically added to the pen position voltage at feedback amplifier IC3.

This stage, in turn, applies feedback voltages to the signal comparator network as previously described.

d. When the system is at null or rest, rate feedback will be zero while input and position signals are equal. The rate feedback circuit is effective only when the system is approaching balance; at which time its voltage subtracts from the error signal thus causing the balance motor to anticipate the correct stopping point without excessive overshoot.

e. The "motor stall shutdown circuit" shown in the block diagram of Figure 1-1 functions precisely as its name implies. To protect the balance motor and its associated clutch mechanism, this circuit automatically reduces the driving signal whenever the motor is stalled for more than a few seconds. The circuit employs a pair of J-FET transistors (Q1 and Q2) which are connected in parallel across the signal path. One transistor is biased as a positive signal switch and the other as a negative signal switch. If the drive signal reaches a positive or negative 10- to 12-volt level, one of the transistor switches will "turn on"--thus reducing voltage to the servo power amplifier by effectively grounding the signal through a low resistance. Switching action is purposely delayed by sampling the drive signal through slow time-constant networks.

f. Reference voltage for the servo feedback pot is supplied from a zener-regulated source. Cal Adjust R20 is provided in the reference circuit for precise adjustment of this voltage. The approximate reference potential supplied across the active portion of the X-axis feedback pot is +1.5 volts, while the Y-axis pot receives +1 volt.

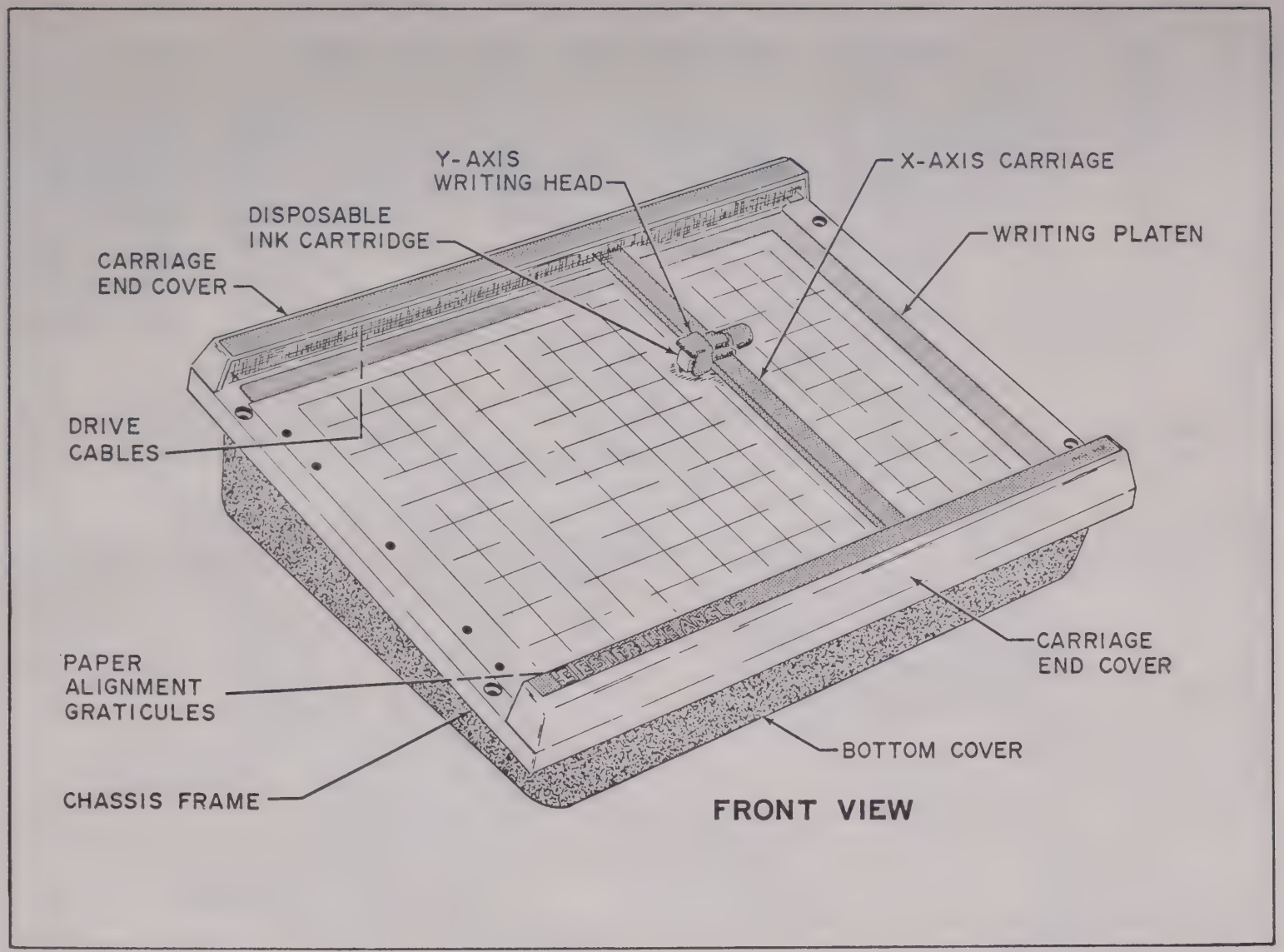


Figure 1-2A. Location of Major Components.

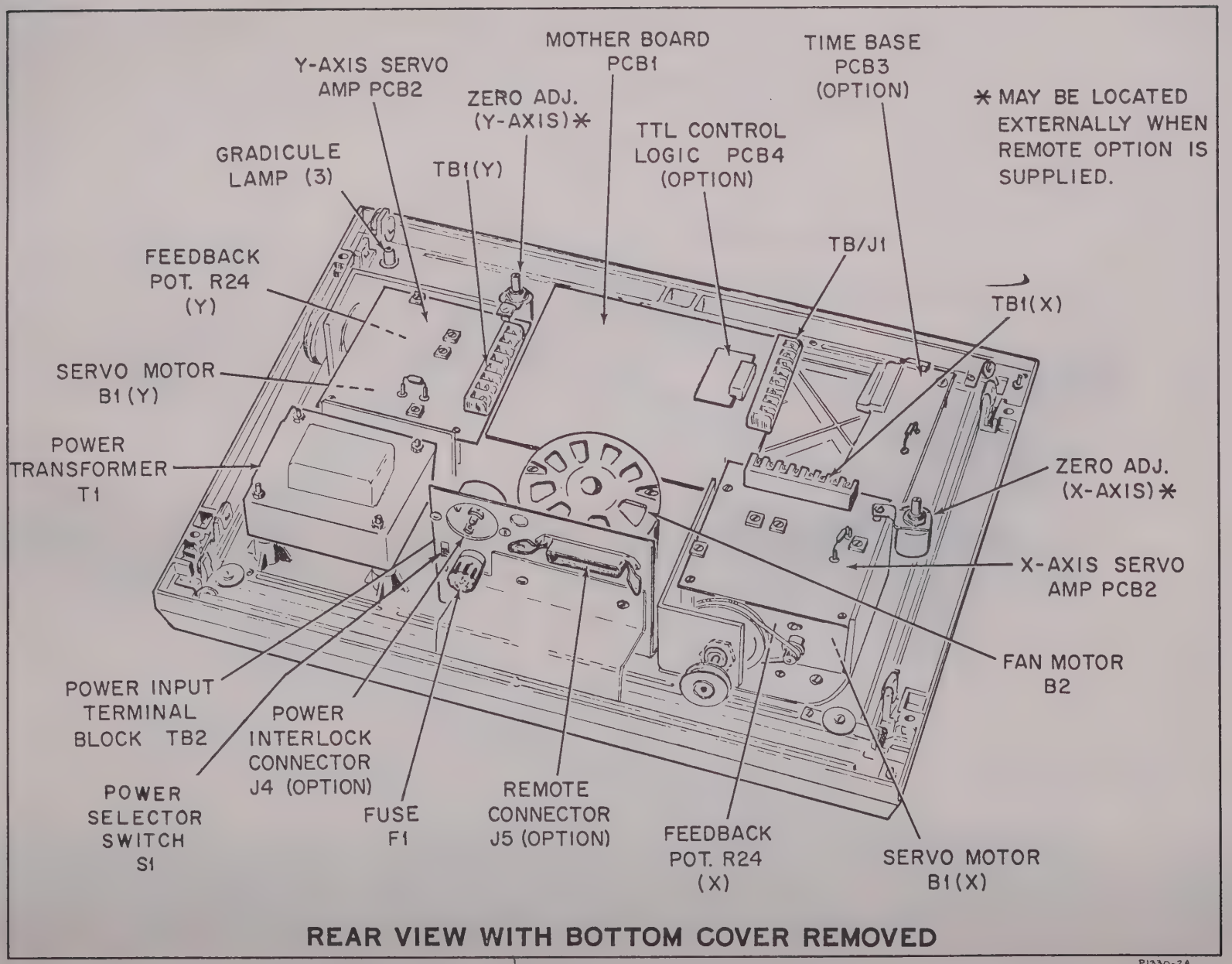


Figure 1-2B. Location of Major Components.

SECTION 2 – INSTALLATION

2.1 UNPACKING INSTRUCTIONS

a. The following standard items have been inspected and carefully packed in the Model XY-575 shipping carton. Optional items are supplied only if originally ordered.

ITEM	QTY.
Recorder Chassis (with bottom cover)*	1
Ink-Cartridges (6-Pack)	1
Graph Paper, English or Metric	Box of 100 Sheets
Instruction Manual	1
Remote Connector Plug (Option)	1 A/R
Mask, Writing Platen† (Option)	1 A/R

* Will include Control Module, if ordered.

† For use with small size graph paper.

b. Remove the packing material carefully and check off all items listed on the packing slip as they are unpacked. If special items were ordered, they will appear on the packing slip. After all items have been removed, make a complete inspection of the shipment for physical damage. If the shipment has been damaged in transit, notify the carrier and Esterline Angus immediately.

CAUTION: Do not attempt to operate a damaged instrument.

2.2 MOUNTING THE RECORDER

The versatile Model XY-575 recorder may be used as a bench instrument by simply placing it horizontally on its bottom cover, or it may be mounted in a rack or panel as a

permanent installation. Figure 2-1 provides recorder dimensions, as well as information for panel mounting. Dimensions have also been provided which will be of assistance when selecting the hardware required for rack or panel mounting (screw length will depend on panel thickness).

2.3 CONNECTIONS

Connection methods for power and signal input will depend upon the model supplied and options ordered. All standard variations are covered in the following paragraphs.

2.3.1 Power Connections

a. The recorder has been pre-set at the factory for the power input specified upon order. This input, reflected on the Data Sheet, should agree with the voltage appearing on the Power Selector Switch located on the rear panel of the Vacuum Fan and Power assembly. If it does not agree, or if an input other than that specified is to be used, then the switch position must be changed to agree with the input to be used (115V AC or 230V AC), and the fuse must be checked and changed,(if necessary) to the correct rating as follows:

1. For 115V AC (50-60 Hz) input, use a 1A, 250V Slo-Blo fuse.
2. For 230V AC (50-60 Hz) input, use a 0.5A, 250V Slo-Blo fuse.

CAUTION: Do not change the switch from one input to another without testing source voltage and changing the fuse.

b. Whether a power cord is supplied or connections are made directly to the recorder in the field, it is imperative that the ground connection from the instrument be terminated at a satisfactory earth ground (such as a water pipe). When making internal

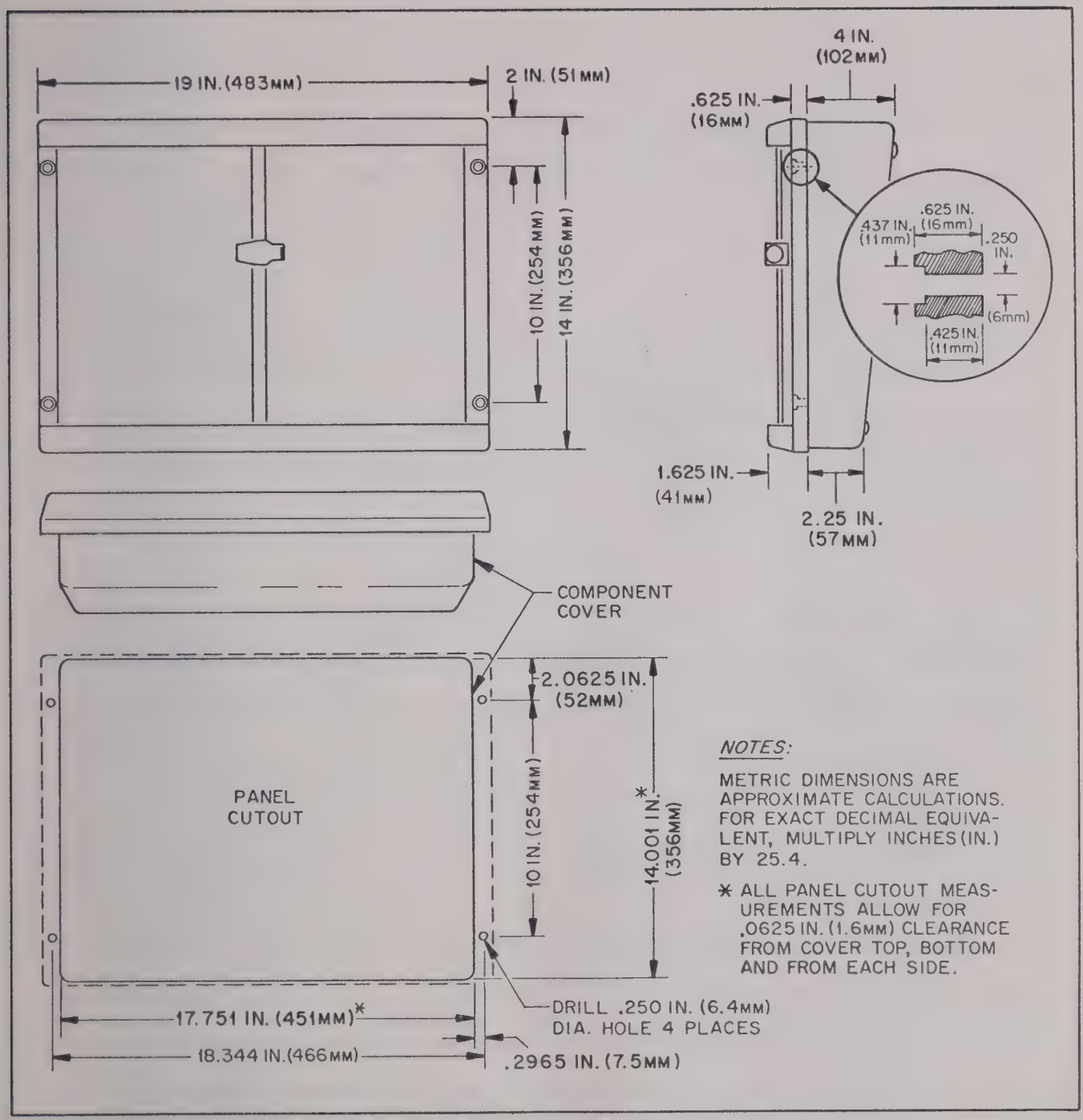


Figure 2-1. Installation and Dimensional Diagram (Basic Model).

NOTE: See Figure 6-1 in SECTION 6 of manual for installation and dimensional diagram of recorder with Control Module (LAB model).

connections, connect the earth ground lead to terminal 5 of TB2. This terminal block is located on the Vacuum Fan and Power assembly. On basic models, an external power switch may be installed by removing jumper wire and connecting switch across terminals 1 and 2 of TB2.

c. POWER CORD SUPPLIED: When a power cord has been supplied and is already attached to the instrument, simply plug it into the appropriate power supply outlet. If the Power Interlock option is supplied, first twist the interlock-cabling plug onto the receptacle located on the Vacuum Fan and Power panel, then plug the other end of the cable into the power source.

d. WITHOUT POWER CORD: When power cord options have not been ordered, power connections must be made directly to the power input terminal block (TB2)--located on the Vacuum Fan and Power assembly. To make proper connections, refer to the connection decal located inside the bottom cover, or to the wiring diagram in this manual.

2.3.2 Signal Input Connections

a. Although both signal axes are designed for single-ended inputs, two-wire shielded cable is generally recommended for most applications. The Low (-) signal input is isolated from chassis ground within the recorder to permit floating common-mode operation. Signal commons for each axis (X and Y) are also isolated from each other to prevent interaction and to provide a means for making different input-signal terminations.

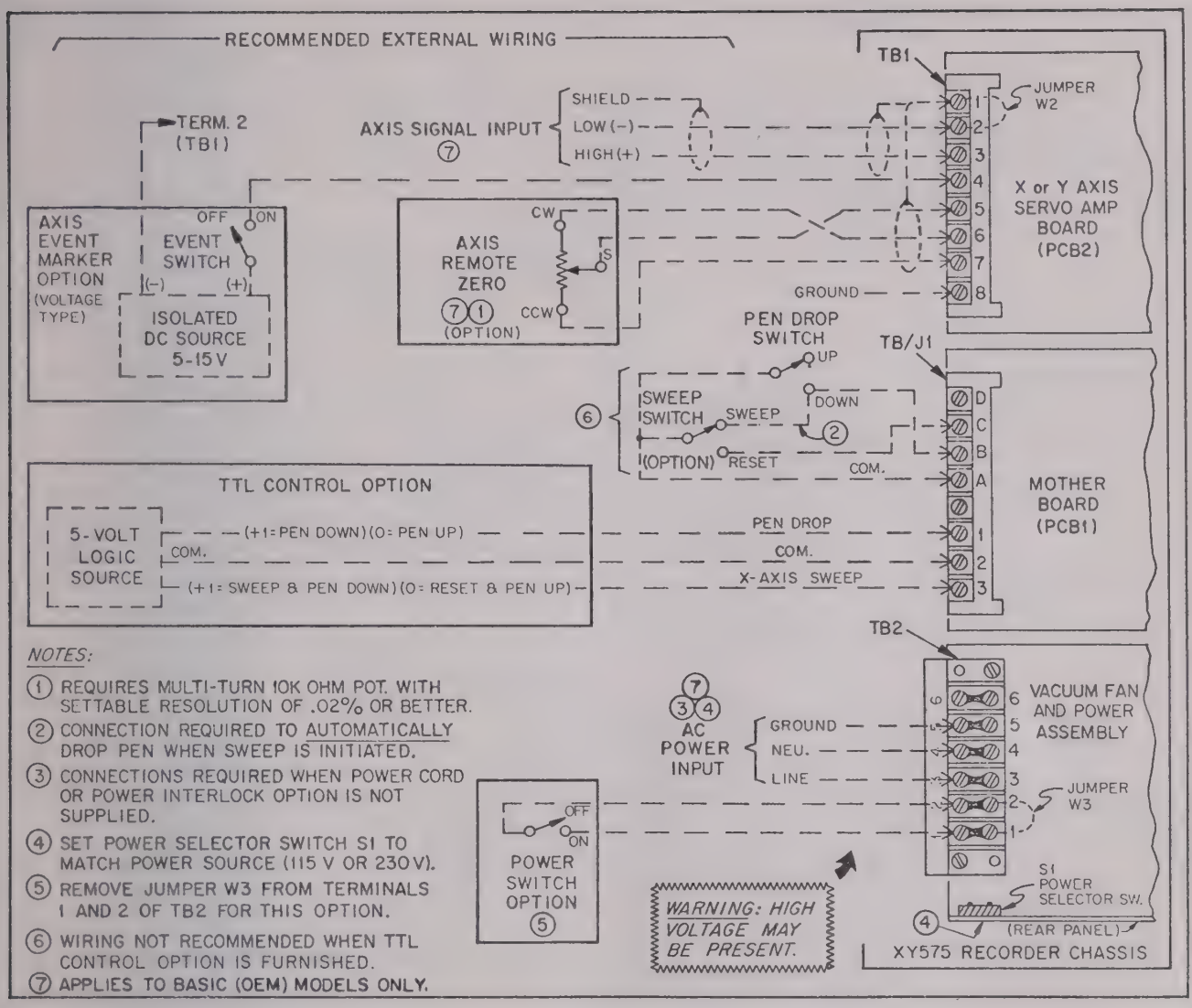
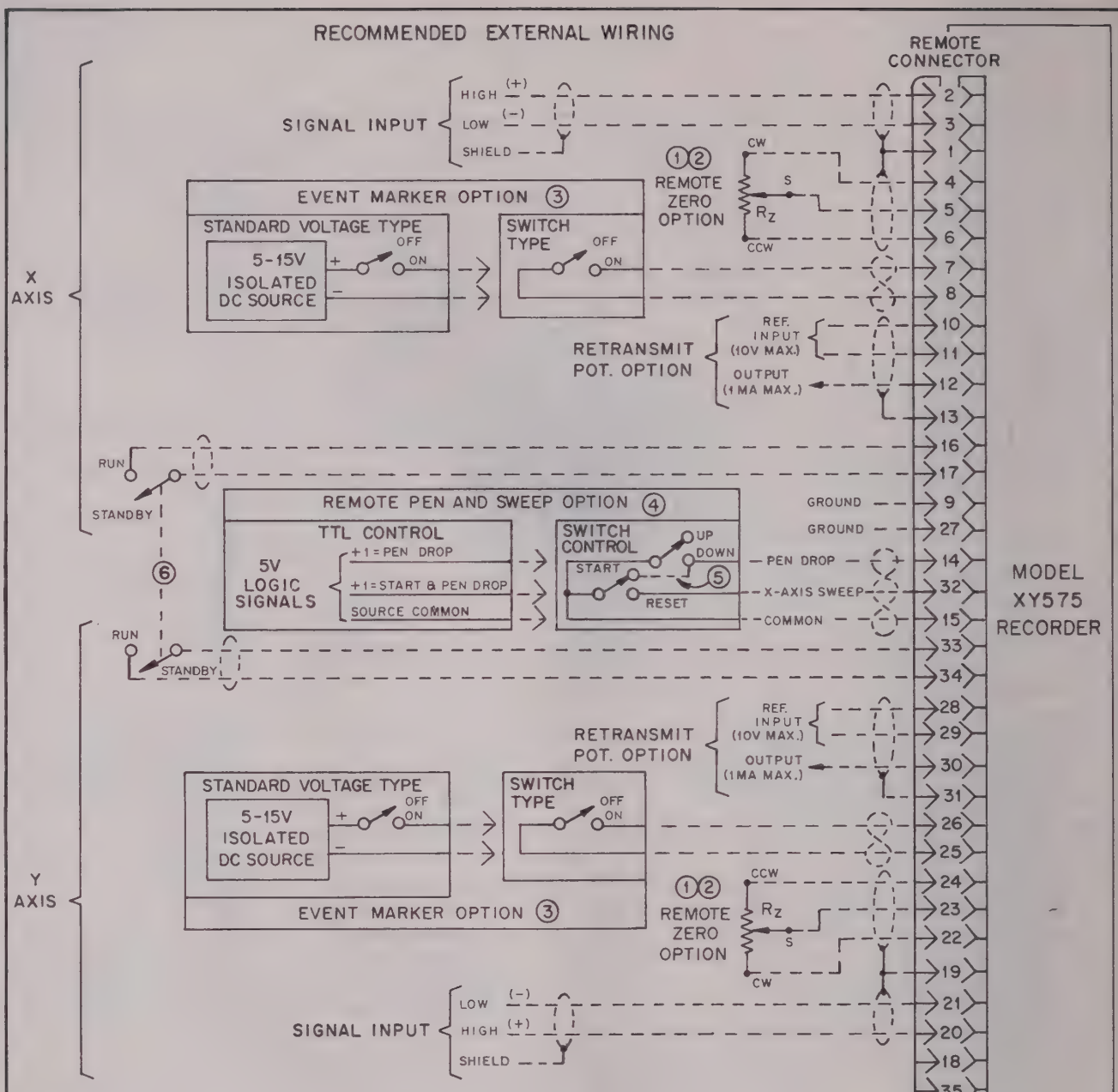


Figure 2-2. External Connection Diagram.



NOTES:

① Supplied on Basic Models only.

② Requires multi-turn 10K ohm pot with settable resolution of .02% or better.

③ Recorder is wired for only one type of actuation--either VOLTAGE or SWITCH (see Data Sheet).

④ Wire only one function--either TTL or SWITCH (see Data Sheet). Lab models; remove jumper from P5 (pins 15 & 32); position "local" recorder switches correctly (Pen "Up" & Sweep "Reset"); for local operation, place remote switches in the same positions.

⑤ Connection required to automatically drop pen when sweep is initiated.

⑥ Requires DPST switch. Use 2-wire shielded cable for remoting distances over 2'. Connect X-axis shield to terminal #1 of P5 and Y-axis shield to terminal #19 of P5. For Lab models, either recorder or external switch must remain in "STANDBY" position during selected (local or remote) operation.

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Figure 2-3. Remote Connector Wiring Diagram (see notes).

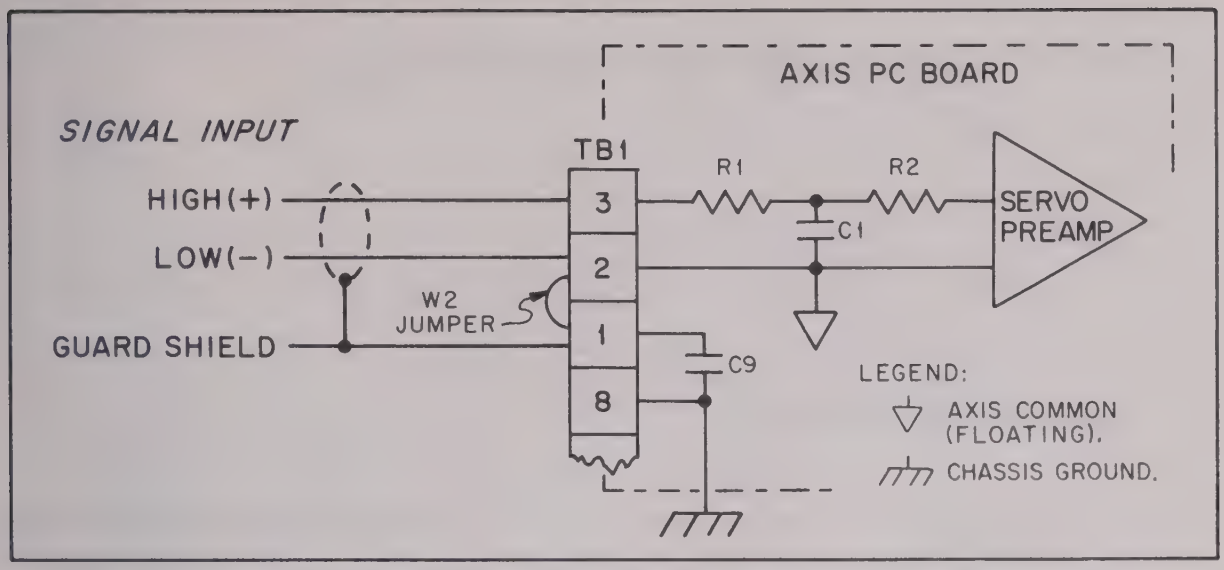


Figure 2-4. Internal Signal Input Wiring for Basic (OEM) Recorders.

b. Input shielding may be terminated both at the signal source and at the recorder; however, objectionable ground loops are usually minimized by grounding at only one point in the input circuitry. If the Low side and shield are grounded at the signal source, internal jumper W2 may be removed from across terminals 1 and 2 of TB1 (see Figure 2-4). Another alternate configuration might be to connect a floating input shield directly to ground at the recorder (terminal 8 of TB1).

CAUTION: Maximum signal input without voltage dividers is ±15V DC. Maximum common mode is ±200V DC.

c. BASIC RECORDER: Signal input connections can be made directly to terminal blocks TB1-X and TB1-Y located on the respective Servo Amplifier PC boards. Refer to Figure 2-2 or to the connection decal located inside the bottom cover for specific connection information.

NOTE: Signal input connections for LAB recorders are made to signal input jacks on the control panel (see Figure 6-3).

d. REMOTE SIGNAL INPUTS: When the Remote Connection option is supplied, all internal connections will have been completed at the factory. However, signal input

leads must be wired to the Remote Connector Plug (P5) in the field. Refer to Figure 2-3 for the correct pin connections.

2.3.3 Remote Control Connections

a. BASIC (OEM) MODELS: Remote control capabilities for signal inputs, zero adjustment, pen drop, sweep/reset control, event markers, retransmit pots, and run/standby switching may be provided when the optional Remote Connector is supplied. Refer to Figure 2-3 for correct pin connections to Remote Connector plug (P5). Remote functions for signal inputs, zero adjustment, pen drop, sweep/reset control, voltage-type event markers, and power on/off can also be achieved on recorders not having the optional remote connector by simply wiring external controls directly to terminal blocks located within the instrument. This method of wiring, however, will not offer the operator the quick disconnect feature provided by the total remote option. To make direct internal connections, remove four screws that secure the bottom cover and refer to Figure 2-2 or to the connection decal located inside the cover.

b. LAB MODELS: Remote control capabilities for signal inputs, pen drop, sweep/reset control, event markers, retransmit pots, and run/standby switching may be provided when the Remote Connector option is supplied. Refer to Figure 2-3 for correct pin connections to Remote Connector plug (P5). A jumper wire is supplied on P5 for local operation of the pen drop switch; remove this jumper to wire remote switch. When this instrument is not supplied with the remote connector option, external connections may be made to internal screw terminals for the following remote functions: pen drop, sweep/reset control, voltage-type event markers, and power on/off. To make direct internal connections, remove four screws that secure the bottom cover and refer to Figure 2-2 or to the connection decal located inside the cover.

SECTION 3 — OPERATION

3.1 GENERAL

This instruction section describes the controls and operating procedures for the basic version of the Model XY-575 Recorder. For operating controls on LAB models refer to SECTION 6 in manual. The functional descriptions which follow for the BASIC recorder controls also apply to the corresponding controls which are located on the LAB model control panel.

3.2 FUNCTION OF BASIC CONTROLS

a. Operating controls necessary for the basic recorder are wired externally either by direct connection to internal terminal blocks or through an optional remote-control connector. These primary adjustments include the following:

(1) Two ZERO ADJUST controls -- one for the X axis and one for the Y axis (external option).

(2) Power switch -- controls AC power to recorder (external option).

(3) PEN DROP switch -- raises or lowers the writing head electrically.

b. Functions of the basic controls are described in the following paragraphs.

3.2.1 Zero Controls

The X-axis and Y-axis ZERO ADJUST controls are used to set the zero reference position for each respective axis. Zero of each axis may be offset ±100% of the full graph scale.

NOTE: Refer to ¶4.6.1 in the Maintenance Section of this manual for zero offset adjustment procedures.

3.2.2 Power Switch

This switch may be wired in series with the AC line (see connection diagram). The "on" position of this switch applies AC power to the recorder. The "off" position removes power completely.

NOTE: Power switch must be "on" in order for PEN DROP switch to function and lower the pen tip onto the graph paper.

3.2.3 Pen Drop Switch

With POWER switch "on", the "off" position of the PEN DROP switch will lift pen "up"; the "on" position drops pen "down". Any SPST contacting-device may be used. The circuit controls 30-volts at approximately 250 milliamperes.

NOTE: Removal of instrument power will lift pen "up" regardless of PEN DROP switch position.

3.3 OPERATING PROCEDURES

Prepare recorder for operation by performing the following steps:

NOTE: For location of operating controls on LAB models, refer to Figure 6-3 in SECTION 6 of manual.

3.3.1 Preliminary

a. Make sure that external connections have been made as shown in Figure 2-2 or 2-3. Place POWER switch in "off" position.

b. DO NOT apply measuring signals to X-axis and Y-axis signal input leads at this point. Connect shorting jumpers between terminals 2 and 3 of each TB1 or, if remote option is supplied, between pins 2 and 3, and between pins 20 and 21 on connector P5. Plug connector P5 into remote connector (J5, Figure 1-2B) at rear

of recorder.

NOTE: For LAB models without remote option, connect short across (+) and (-) input jacks on control panel.

c. Turn ZERO ADJUST controls (both axis) to maximum clockwise position. Then, make 4 turns in the counterclockwise direction.

d. Place PEN DROP switch in its "off" position.

e. Place POWER SELECTOR switch (S1, Figure 1-2) in appropriate position (either 115 V or 230 V) to match power source requirements.

NOTE: A 1A line fuse is required for 115 V operation, and a 0.5A fuse for 230 V operation.

f. Make necessary power connections to recorder as described in Section 2 installation procedures.

3.3.2 Writing System

a. The writing system consists of a disposable fiber tip pen and ink cartridge assembly (red ink is standard). The cartridge snaps into a spring-clip holder located at the front end of the writing head. Initial installation and routine changing of the snap-in cartridge should be performed with power to recorder turned off.

NOTE: Before installation or changing of ink cartridge, it is recommended that a scrap sheet of paper be placed beneath the writing head for temporary use as a buffer to prevent markings of ink on writing platen or graph paper (if already inserted). After cartridge has been installed or changed, remove buffer paper.

b. INITIAL CARTRIDGE INSTALLATION

(1) An accessory package of 6 red-ink cartridges is shipped with the recorder. Protective caps are placed over the fiber tip pens.

(2) Obtain ink cartridge from accessory supplies. Remove protective cap from pen tip.

(3) Grasp cartridge between thumb and forefinger, and position cartridge so that pen tip faces away from the spring-clip holder in writing head.

(4) Place bottom, rear end of cartridge between side clips of holder. Then, pivot cartridge upward and push inward until detent on each side of cartridge slides past the clip and fastens.

c. CHANGING CARTRIDGE

(1) Grasp old cartridge between thumb and forefinger. Pull cartridge outward with a side-to-side motion until cartridge is freed from spring-clip holder.

(2) To install new cartridge, perform Steps (2) through (4) under "Initial Cartridge Installation".

d. PEN CARE

(1) The disposable fiber tip pen and cartridge assembly provides a neat and clean inking system. Clogging, blotting, priming, skipping, and the necessity for cleaning have been eliminated.

(2) If recorder is not to be used for several days, place protective cap over fiber tip pen to prevent drying out. Should the pen fail to write after periods of non-use, inking can generally be resumed by merely moistening the fiber tip of the pen.

3.3.3 Initial Paper Insertion

NOTE: Also, see paragraph 3.3.5.

a. An accessory package containing 100 sheets of calibrated graph paper is supplied with the recorder.

b. Insert and position graph paper on writing platen as follows:

(1) Apply power to the recorder with POWER switch. Carriage bar (X axis) and writing head (Y axis) should self-balance within the normal recording area of the writing platen. Adjust ZERO controls if necessary.

(2) Place scrap sheet of paper beneath writing head for temporary use as a buffer to absorb any accidental ink markings (if pen is installed) and to permit easier sliding of graph paper beneath carriage bar as in Step 3.

NOTE: For small size paper, it is recommended that optional mask No. 733C27 be placed over platen with air holes properly aligned.

(3) Obtain sheet of graph paper from accessory supplies. Insert right-hand side of graph paper between writing platen and buffer sheet, and slide graph paper underneath carriage bar. Remove buffer sheet of paper.

(4) Align grid on graph paper with the illuminated graticules on writing platen as shown in Figure 3-1. Air vacuumed through holes in the writing platen will hold paper in place.

NOTE: Although a platen is available for metric graph paper, ISO "A3" size paper may be used on recorders with standard platens by aligning inter-grid lines with graticules for zero references.

3.3.4 Record Mode

(1) Place POWER switch in "off" position.

(2) Remove signal-input shorting jumpers that were connected in Step 3.3.1b, and apply signals to be measured to the X- and Y-axis input leads.

> CAUTION: Maximum signal input without voltage dividers is ±15V DC. Maximum common mode is ±200V DC.

(3) Place POWER switch in "on" position. A positive input signal will drive the horizontal X-axis to the right and the vertical Y-axis upward.

> NOTE: Noisy input signals or improper grounding at the input may result in unpredictable fluctuations in the recorder. If this condition is allowed to persist, it will cause excessive wear in the feedback potentiometers. Mechanical stops and a slip clutch are provided to prevent damage to the drive mechanism or the feedback potentiometers if an overrange signal is applied to the input terminals. The slip clutches will emit an audible noise to alert the operator of the overrange condition. Do not permit clutches to slip for long periods of time.

(4) Set X- and Y-axis ZERO ADJUST controls for desired offsets (±100% of graphic scale) applicable to the measuring requirements.

(5) Lower the pen and begin recording by placing PEN DROP switch in its "on" position.

3.3.5 Routine Changing of Paper

After paper has initially been inserted at start-up of operations, routine changing of the paper may be accomplished as follows:

(1) Set POWER switch and PEN DROP switch in their "off" positions.

(2) Manually position carriage bar and writing head to their mid-travel positions.

(3) Remove existing graph record from writing platen. Slide right-hand side of new graph paper sheet underneath carriage bar.

(4) Turn POWER switch "on". With X- and Y-axis servo action initiated, align grid on graph paper with the illuminated graticules on writing platen as shown in Figure 3-1.

(5) Set PEN DROP switch to "on" position so that pen begins to record on graph paper.

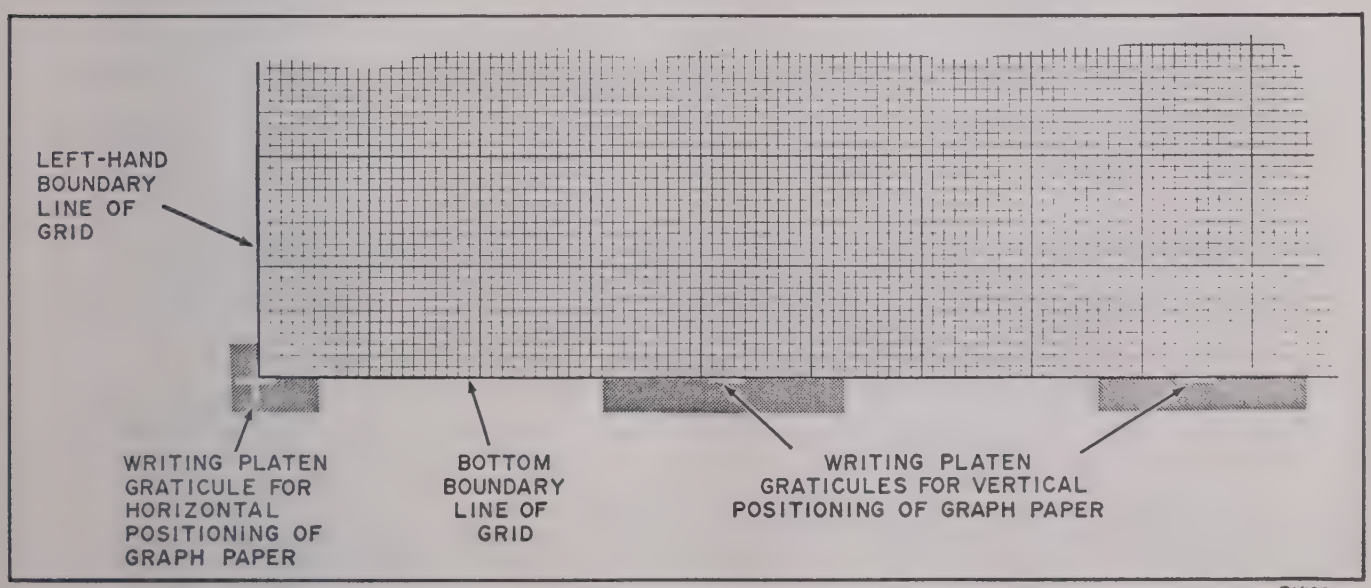

LEFT-HAND BOUNDARY LINE OF GRID
WRITING PLATEN GRATICULE FOR HORIZONTAL POSITIONING OF GRAPH PAPER
BOTTOM BOUNDARY LINE OF GRID
WRITING PLATEN GRATICULES FOR VERTICAL POSITIONING OF GRAPH PAPER
P1428

Figure 3-1. Graph Paper Alignment.

SECTION 4 — MAINTENANCE

4.1 INTRODUCTION

a. This section of the manual is devoted to the general upkeep and routine maintenance procedures required for Model XY-575 Recorders.

NOTE: Refer to supplemental instructions if maintenance procedures are required for optional attachments or special modifications.

b. Periodic maintenance schedules should be established and followed to ensure trouble-free operation. Where extreme temperatures or contaminated atmospheres prevail, maintenance scheduling should be more frequent. Since frequency of use and environment conditions will vary, maintenance scheduling is left entirely up to the discretion of the user. Routine maintenance will consist primarily of a general inspection of all electrical and mechanical components, cleaning, replacement of graph paper and ink cartridges, and a calibration check when desired.

c. All functional systems of the recorder are accessible with the bottom cover removed from the chassis frame. Refer to Figure 1-2 for the location of all major components.

4.2 INSPECTION

A complete visual inspection of the instrument should be made at each routine maintenance period in order to detect the possible onset of a malfunction. Particular attention should be given to the following:

WARNING: Disconnect power and high-potential signals before removing instrument cover.

(1) SUPPLIES: Recording pen excursions will determine the frequency with which the writing system will run out of ink. A simple record of cartridge and graph paper usage will be a handy reference during inspection periods. Also check the reserve of these items at this time to assure that an adequate supply is on hand.

(2) DIRT: Check for accumulation of dirt, dried ink or other foreign bodies on the pen tip, writing platen, and in all moving parts of the carriage and writing head assemblies.

(3) CONNECTIONS: Look for damaged wiring and loose connections at the internal terminal blocks, at lead connector posts on PC boards, and at all cable connectors.

(4) MECHANICAL DRIVES: Test for freedom of movement in the X-axis carriage assembly and in the Y-axis writing head assembly. Check tension of servo drive cables and gear-belt couplings. Make sure that all mounting hardware items are tight.

(5) VACUUM HOLD DOWN: See that vacuum fan motor is operating properly and that air passages are not restricted.

(6) CONTROLS: Test functional condition of all operating controls and switches.

4.3 CLEANING

a. Regardless of the precautions taken, dirt and dust will enter the recorder chassis area; therefore, periodic cleaning of the exposed components within the instrument will be required.

b. A soft-bristled brush or low vacuum system, a lint-free cloth, and a suitable solvent are all that are required to clean the interior of the instrument. Mild soap or detergent may be used to clean the writing platen or optional mylar mask, front surfaces, and bottom cover. Do not use harsh solvents as they may damage certain components. Esterline Angus recording ink is water based and can be removed with a wet cloth.

CAUTION: Exercise care to avoid disturbing electrical wiring and mechanical alignment of parts when cleaning internal components.

c. The servo drive cables should be kept clean at all times. A dry lint-free cloth may be used for this purpose. Grease or oil deposits may be removed by moistening the cloth with a commercial petroleum solvent.

CAUTION: Do not lubricate pulleys, cables, or gear-belt systems.

4.4 LUBRICATION

a. The only component in the instrument that will require periodic lubrication is the vacuum fan motor. Using an external vacuum system, first clean the motor thoroughly and then place about 5 drops of oil in the opening at each end of the motor housing. The top opening is accessible through a hole at the rear of the mounting bracket. Remove impeller cover to gain access to hole in bracket. Oil the motor every 12 months with a good commercial grade of #20 non-detergent motor oil. Never over lubricate -- always wipe off excessive oil before exposing instruments to dirt-laden atmosphere.

CAUTION: Do not lubricate servo-drive mechanisms.

b. All drive pulleys contain shielded ball bearings that will not require relubrication. The servo motor, feedback pot and output sheave bearings are oil-impregnated and should also not require attention in the field.

4.5 MECHANICAL ADJUSTMENTS

It may be necessary to perform the following adjustments in the field when a visual inspection or recorder performance indicates. Refer to Figure 4-1 for the location of adjustment points.

4.5.1 Cable Tension

a. Tensions of the X and Y drive cables are precisely adjusted at the factory prior to "run in". It is anticipated that these cables will stretch within time--especially in high-speed applications. Tautness need not be readjusted, however, until cable deflection exceeds the following limits when a weight is suspended on each cable as described in paragraphs 4.5.1c and d.

X-axis Cable = 1/4" (+5/16", -0") Deflection.

Y-axis Cable = 3/8" (+5/16", -0") Deflection.

NOTE: Recording accuracies will not be adversely affected if cable tensions are maintained within the above specified limits. Replace cables if more than three readjustments become necessary by referring to paragraph 4.8 in manual.

b. Since response characteristics of one axis can be affected by the cable tension of the other axis, the X and the Y cables should both be adjusted. To adjust cable tension, disassemble instrument as follows:

(1) Turn off power and disconnect all dangerous potentials from recorder.

(2) Remove two screws from each side of bottom cover and remove cover from chassis frame.

(3) From under side of chassis, remove three self-tapping screws securing one carriage end cover to front frame. Remove cover from chassis.

(4) Drive cabling systems are now exposed at both front and rear of recorder chassis; proceed with the following adjustment instructions.

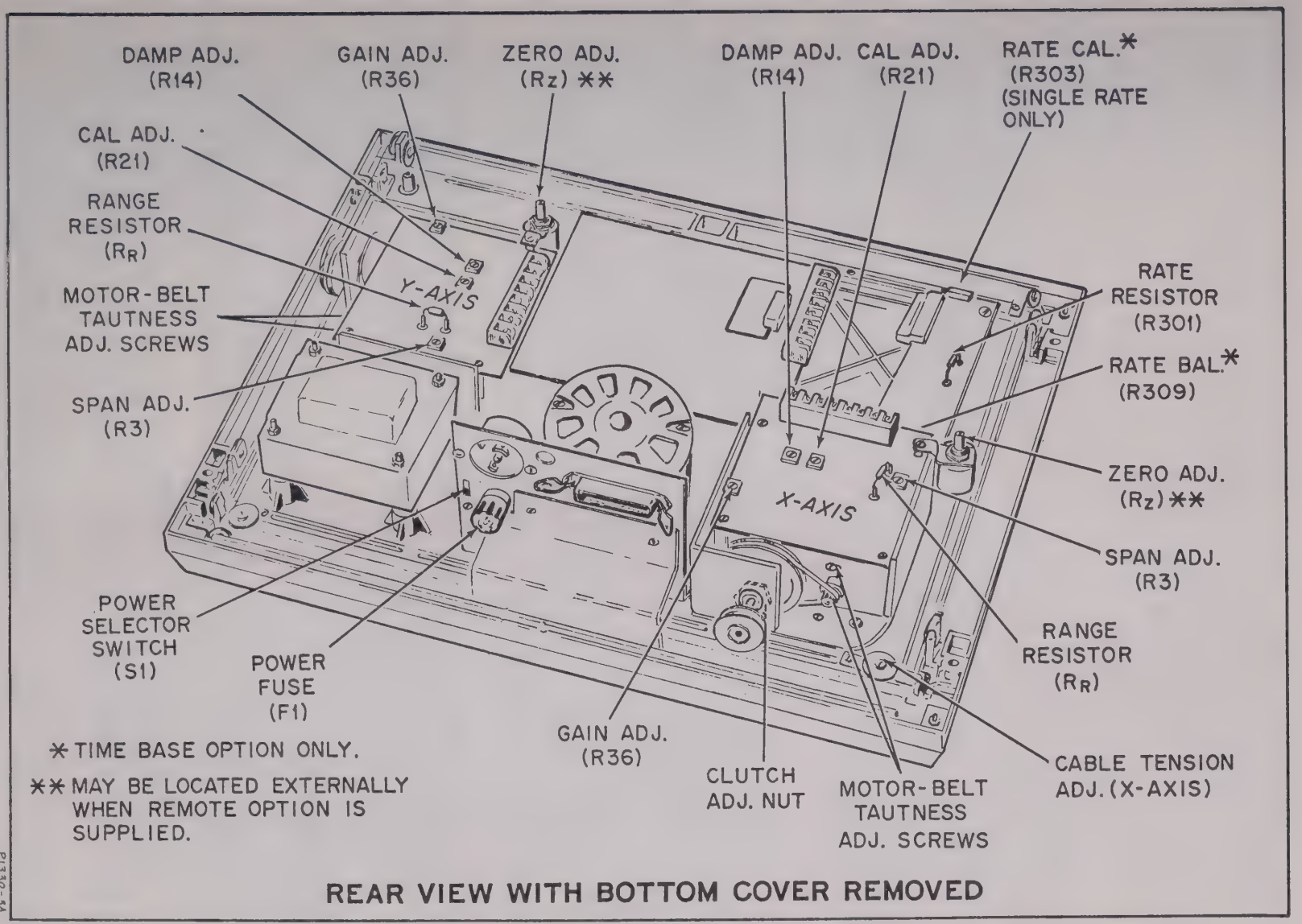


Figure 4-1. Location of Service Adjustments.

NOTE: It is recommended that chassis frame be supported in a vertical position for servicing.

c. X-AXIS CABLE:

(1) Secure chassis frame in vertical position, then manually move X-axis carriage bar to one end of its travel (zero or full scale).

(2) Locate X-axis drive cable at front of instrument where carriage end cover was removed.

(3) Hang 50-gram weight on X-axis cable midway between the two end pulleys. Cable should deflect from its normal position 1/4 inch (± 1/16") with proper tension.

(4) If tension is not within tolerance, locate X-axis adjustment pulley. This pulley is on component side of chassis in one corner of frame (see Figure 4-1).

(5) Loosen screw securing pulley to its slotted mounting bracket. Slide pulley in proper direction to achieve specified cable tension.

(6) Tighten pulley screw and then move X-axis carriage back and forth several times. Recheck tension measurement and repeat adjustment if necessary.

d. Y-AXIS CABLES:

(1) Secure chassis frame in vertical position, then manually move X-axis carriage bar to one end of its travel (zero or full scale).

(2) Locate Y-axis drive cable at front of instrument where carriage end cover was removed.

(3) Hang 50-gram weight on Y-axis cable midway between its two end supports. Cable should deflect from its normal position 3/8 inch (± 1/16") with proper tension.

(4) If tension is not within tolerance, locate tie post at one end of Y-axis cabling. This is a cable clamp and terminal assembly on the front side of chassis.

NOTE: Two cables are used on Y-axis drive but only one adjustment is required.

(5) Loosen 1/4" hex nut securing cable at tie post. Extend or retract end of cable enough to achieve specified cable tension.

(6) Tighten tie post nut and then move Y-axis writing head up and down carriage bar several times. Recheck tension measurement and repeat adjustment if necessary.

(7) Restore instrument to operation by reversing disassembly procedures.

4.5.2 Drive Belt Tension

a. Adjustment of belt tension may be necessary if components in a servo motor drive assembly have been replaced in the field, or if a belt has stretched after long periods of operation. If a drive belt is too loose, the axis servo system may tend to "hunt". If a belt is too tight, excess friction occurs and erratic servo response may result.

b. To adjust belt tension, turn off power and disconnect all dangerous potentials from recorder, remove bottom cover, and proceed with the following steps:

(1) Check belt tension at servo drive assembly. Belt should be tight enough for its teeth to snuggly mesh with teeth on the small motor pulley, but loose enough so that the belt can be easily moved from side-to-side on the teeth of the larger output pulley.

(2) If adjustment is necessary, loosen the two servo-motor mounting screws located directly above and below the motor shaft, as pointed out in Figure 4-1. Loosen the screws just enough to permit slight movement of the servo motor.

(3) To tighten belt, carefully move pulley and motor-shaft assembly away from the larger output pulley; to loosen belt, move assembly toward the output pulley.

CAUTION: Do not use tool or excessive force that could bend motor shaft.

(4) Once proper tension is obtained, tighten motor mounting screws and check recorder operation.

4.5.3 Clutch Adjustment

NOTE: The purpose of the slip clutches in the XY-575 servo drive systems is to minimize the force applied to the drive cables when the X-axis carriage or the Y-axis writing head impacts the mechanical stops at high slew speeds. Improperly adjusted clutches can affect cable life as well as the dynamic response to step input signals. No clutch slippage on impact will tend to stretch the drive cable; whereas, excessive clutch slippage will result in inconsistent damping of the writing head.

4.5.3.1 TO CHECK CLUTCH OPERATION

To check a servo clutch adjustment, turn off power, disconnect signal inputs from recorder, remove bottom cover, and proceed with the following steps:

(1) Apply rated power to recorder and allow instrument to warm up for a few seconds.

(2) Adjust Zero controls so that X-axis carriage and Y-axis writing head are positioned at midscale on their respective axis.

(3) Position recorder chassis so that platen is vertical and bottom side is facing you.

X-Axis Check

(a) Manually turn and hold X-axis sheave to an off-null balance position. Clutch should slowly slip. If clutch doesn't initially slip, trigger slippage by manually turning drive belt (see Figure 4-1A).

NOTE: Clutch slippage must occur in one direction.

(b) To check for proper adjustment, connect DC ammeter in series with one side of servo balance motor; and observe current being drawn by motor. For proper clutch slippage, ammeter should read 1A (1000 mA) or greater; adjustment is too loose if ammeter reads less than 1A.

Y-Axis Check

(a) Manually turn and hold Y-axis sheave to an off-null balance position. Clutch should slowly slip. If clutch doesn't initially slip, trigger slippage by manually turning drive belts (see figure).

NOTE: Clutch slippage must occur in one direction.

(b) Perform same procedures as per Step b under "X-Axis Check".

4.5.3.2 TO ADJUST CLUTCH

Field adjustment of a servo drive clutch may be required if components have been replaced in the drive system or if drive frictions change due to wear. Both X- and Y-axis clutches should be adjusted if they fail to meet the operational checks given under paragraph 4.5.3.1. See figure for location of clutch adjustment nut. Proceed with adjustments as follows:

(1) Use 1" open-end wrench; and turn clutch adjustment nut clockwise to tighten clutch or counterclockwise to loosen clutch.

(2) After adjustment is made, repeat clutch checking procedures under paragraph 4.5.3.1 until proper results are obtained.

4.5.3.3 POST ADJUSTMENT PROCEDURES

After performing procedures under paragraph 4.5.3.1 and 4.5.3.2, reassemble bottom cover on recorder, reconnect external signal inputs, apply rated power, and resume normal recording operations.

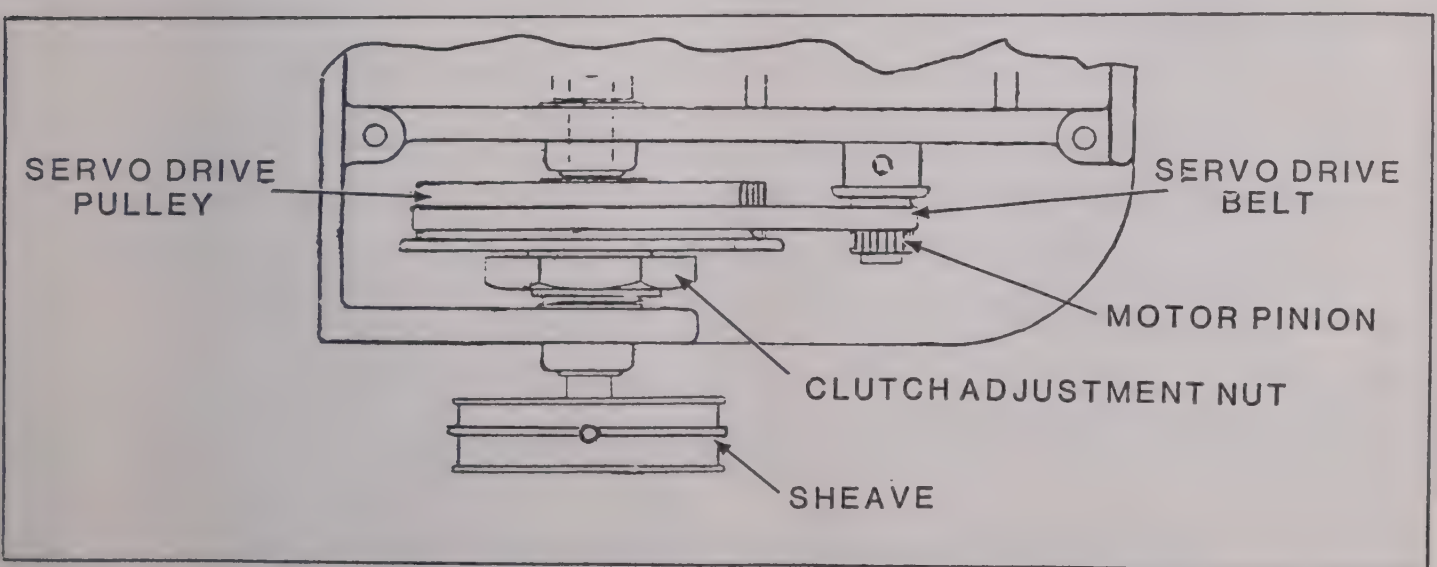


Figure 4-1A. Partial Bottom View of Servo Drive Assembly.

4.6 ELECTRICAL ADJUSTMENTS

a. Model XY-575 recorders will require little or no adjustment of internal electrical controls. For normal recording operations, only the X- and Y-axis zero controls must be set for each measurement application.

> CAUTION: Do not attempt adjustment of other internal controls unless performing instrument calibration.

b. Basic recorders with internal zero adjustments will have a Zero Adjust pot (R_Z) attached to each servo amplifier PC board--as pointed out in Figure 4-1. These controls are screwdriver adjustments accessible through holes in the bottom cover of the instrument. When the remote zero option is supplied, these adjustments will be mounted externally by the user. The zero controls are 10-turn precision potentiometers that offer a minimum electrical zero-offset of ± 100% of the graphic scale.

> NOTE: Refer to SECTION 6 for electrical adjustments on Control Module used in LAB models (see Figures 6-3 and 6-4).

4.6.1 Zero Offset

a. When a measured signal range is within the limits of the calibrated graph paper, zero may be adjusted to position the recording pen at the "0" points on the graph. If negative or both positive and negative signals are to be recorded, electrical zero may be shifted up-scale (elevated) from 0 to + 100% of the graphic spans. If the input signal range is greater than the upper limit of the graph, electrical zero may be shifted down-scale (suppressed) from 0 to -100% of the graphic spans.

b. ZERO ELEVATION: Electrical zero may be elevated by the following procedure:

(1) Remove analog source and connect shorting jumper across "high" and "low" axis input terminals. Apply power and permit instrument to warm up.

(2) Determine desired zero pen position on graph paper. Lower-end value of input signal range equals minimum amount of zero elevation required--disregarding negative sign of input signal voltage.

CAUTION: Signal input voltage must not exceed ± 15V DC, regardless of offset adjustment.

(3) Carefully rotate axis Zero Adjust R_Z until recording pen moves up-scale to point determined in step (2).

NOTE: If graphic calibrations are not directly proportional to desired range; calculate equivalent percentage point on graph grid.

(4) Remove shorting jumper and connect signal source to be measured. Instrument will now record analog inputs over the elevated range selected.

CAUTION: Once offset adjustment is made, do not disturb zero control setting.

c. ZERO SUPPRESSION: Electrical zero may be suppressed by the following procedure:

(1) Disconnect analog source from axis, apply power, and permit instrument to warm up.

(2) Using known-accurate voltage standard, apply input signal to recorder that equals low-end value of desired measurement range. Recording pen will deflect to equivalent position on graph span. If graphic calibrations are not directly proportional to desired range, calculate equivalent percentage point on graph grid.

CAUTION: Signal input voltage must not exceed ± 15V DC, regardless of offset adjustment.

(3) Carefully rotate axis Zero Adjust R_Z until recording pen moves down scale and comes to rest precisely on "0" reference line of graph grid.

NOTE: Graphic "0" now electrically represents low end of desired measurement range.

(4) Disconnect voltage standard from axis input and connect signal source to be measured. Instrument will now record analog inputs over suppressed range selected.

CAUTION: Once offset adjustment is made, do not disturb zero setting.

4.6.2 Service Adjustments

a. The following internal adjustments are factory set and will not normally require operator attention in the field unless they are either inadvertently disturbed or calibration is performed. Only technically qualified personnel having access to precision test instruments should attempt repositioning of these adjustments. The minature potentiometers are accessible by removing the bottom cover from the instrument.

WARNING: Dangerous potentials may be present on exposed internal components. Exercise appropriate caution when making adjustments or servicing.

b. GAIN ADJUST: A Gain pot (R36) is provided for each axis to regulate overall servo-loop amplification. This screwdriver adjustment is located on each amplifier board--as pointed out in Figure 4-1. When gain is set too low, axis response will be sluggish and exhibit excessive deadband; when set too high, the pen may jitter or tend to oscillate. If readjustment becomes necessary on either axis, proceed with the following steps:

(1) Place pen drop switch in UP position, turn off recorder power, and insert sheet of graph paper (approximately 11"x17") having either English or Metric grid graduations.

(2) Connect output of variable DC voltage source to input of measuring axis. Wire shorting jumper across other axis input.

(3) Turn on power, permit instruments to warm up, and zero axis pen. Using zero control of other axis, position pen near center of axis span.

(4) Adjust output of signal source for a 10" (254 mm) axis pen deflection; then place pen drop switch in DOWN position.

(5) Manually deflect pen about 1" along measuring axis by rotating axis drive sheave (large pulley) in one direction; then, permit pen to reposition itself slowly. Slightly offset other axis zero and repeat deflection procedure in opposite direction. Observe traces.

NOTE: Determine distance between two pen-return points (deadband). It should not exceed .015" (.38 mm) on X axis, or .010" (.254 mm) on Y axis.

(6) If gain readjustment is necessary, reduce setting of axis pot R36 until excessive deadband is obvious; then increase setting gradually while repeating step 5. Gain should be as low as possible with acceptable deadband.

NOTE: If gain setting is changed, always check axis damping. These two adjustments are interactive.

(7) After adjustments, check amplifier calibration as described in paragraph 4.9 of this manual.

c. DAMP ADJUST: A damping adjustment (R14) is provided in the servo feedback loop of each recording axis. It is used to vary the amount of rate feedback signal necessary for optimum servo response. This screwdriver adjustment is located on each amplifier board (see Figure 4-1). If readjustment becomes necessary, proceed with the following steps:

(1) Place pen drop switch in UP position, turn off recorder power, and insert standard sheet of graph paper (approximately 11"x 17") having either English or Metric grid graduations.

(2) Using dual-output function generator, connect one output to recorder X-axis input and other output to Y-axis input.

NOTE: Recorder writing platen should be in level horizontal position.

(3) Set generator for "0" outputs, turn on power, and permit instruments to warm up. Place pen drop switch in DOWN position and zero recording pen.

(4) Set both outputs of generator for 0.3Hz square wave that produces 10" (254 mm) pen deflection on each recorder axis.

(5) Change frequency of both generator outputs to 0.5Hz and X-axis output to triangular wave. Observe Y-axis overshoot trace at top and bottom of graph.

NOTE: Y-axis overshoot must be apparent but should not exceed .05" (1.3 mm) at either zero or full scale.

(6) If readjustment is necessary, carefully turn Y-axis damping pot (R14) until desired overshoot is achieved.

(7) Change frequency of both generator outputs to 1.0Hz and Y-axis output to triangular wave. Observe sloping pen-trace lines--they should coincide.

NOTE: Trace and retrace lines should have zero hysteresis. Loops may appear at each end but should not exceed 2" (51 mm) in length.

(8) If readjustment is necessary, carefully turn X-axis damping pot (R14) until proper sloping lines are obtained.

NOTE: If satisfactory indication cannot be obtained, check drive systems for excessive or unequal mechanical friction.

(9) Change frequency of both generator outputs to 0.5Hz and X-axis output to square wave. Observe X-axis overshoot at both left- and right-ends of trace. Overshoot must be apparent but should not exceed 0.7" (18 mm) at either zero or full scale.

NOTE: If damping is changed, always check axis gain. These two adjustments are interactive.

(10) After adjustments, check amplifier calibration as described in paragraph 4.9 of this manual.

d. SPAN ADJUST: A Span pot (R3) is furnished in the signal amplifier circuitry of each axis to provide a fine adjustment of range accuracy. This screwdriver adjustment is located on each servo amplifier board--as shown in Figure 4-1. Procedures for setting this calibration control are described in paragraph 4.9 of this manual.

e. CAL ADJUST: A Calibration control (R21) is provided in the servo system of each axis. It serves to regulate the amount of reference supply voltage applied across the servo feedback potentiometer. This screwdriver adjustment is located on each servo amplifier board (see Figure 4-1). The pot is normally set for an amplifier sensitivity of 100mV/in (50mV/cm). Refer to manual paragraph 4.9 for adjustment procedures.

f. RATE CAL: This trimmer pot is only used when a Time Base option is supplied for the X-axis of a recorder. Its purpose is to fine trim the R-C time constant in the integrator network of the sweep-rate circuitry. This screwdriver adjustment is positioned on Time Base board PCB3 (see R303 in Figure 4-1 or R315 in Figure 6-4). Do not readjust this pot unless performing complete calibration procedures as stipulated in manual paragraph 4.10.

g. BAL ADJUST: The balacing pot (R309) is only furnished with an X-axis Time Base option. Located on Time Base board PCB3, this minature screwdriver adjustment provides a means for nulling out op-amp offset voltage inherent in the integrating stage of the sweep circuitry. Refer to Figure 4-1 or Figure 6-4 for the location of R309. Do not readjust this pot unless performing complete time-base calibration as stipulated in manual paragraph 4.10.

NOTE: Refer to supplemental instructions or consult factory for adjustment procedures involving special response applications.

4.7 CHANGING SENSITIVITY OR RATE

a. In the basic fixed-range recorder, sensitivity is established for each axis by range resistor R_R. This is a precision plug-in component located on the servo amplifier PC Board (Fig. 4-1). To change sensitivity, select R_R from the Amplifier Signal Range Table below and recalibrate as directed in paragraph 4.9c.

AMPLIFIER SIGNAL RANGE TABLE

STANDARD SENSITIVITIES		RESISTOR R_R ASSEMBLY	
English	Metric	Part No.	Ohms ±1%
100 mV/in	50 mV/cm	733B29-1-C	0 (Jumper)
10 mV/in	5 mV/cm	733B29-1-F	86.6 K
1 mV/in	.5 mV/cm	733B29-2-F	953 K
1 V/in	.5 V/cm	733B29-1-F	86.6 K *
10 V/in	5 V/cm	733B29-1-C	0 (Jumper) *

*Also change R1 to 1 Meg and add R45 (10K ±1%) across C1.

NOTE: In LAB model recorders, standard sensitivities listed in table are selectable by RANGE switches located on front panel of control module; and range resistors R_R are always zero ohms (jumper). See Figure 6-3 in Section 6 for switch locations on panel.

b. The sweep rate of the X-axis Time Base option in a basic recorder is determined by plug-in resistor R301. To change rate, select R301 from the Time Base Rate Table below and recalibrate as directed in paragraph 4.10.

TIME BASE RATE TABLE

STANDARD SWEEP RATES		RESISTOR R301 ASSEMBLY	
English	Metric	Part No.	Ohms ±5%
.01 in/sec	.2 mm/sec	733B29-6-C	10 Meg
.05 in/sec	1 mm/sec	733B29-5-C	2 Meg
.1 in/sec	2 mm/sec	733B29-4-C	1 Meg
.5 in/sec	10 mm/sec	733B29-3-C	200 K
1 in/sec	20 mm/sec	733B29-2-C	100 K
2 in/sec	40 mm/sec	733B29-7-C	51 K

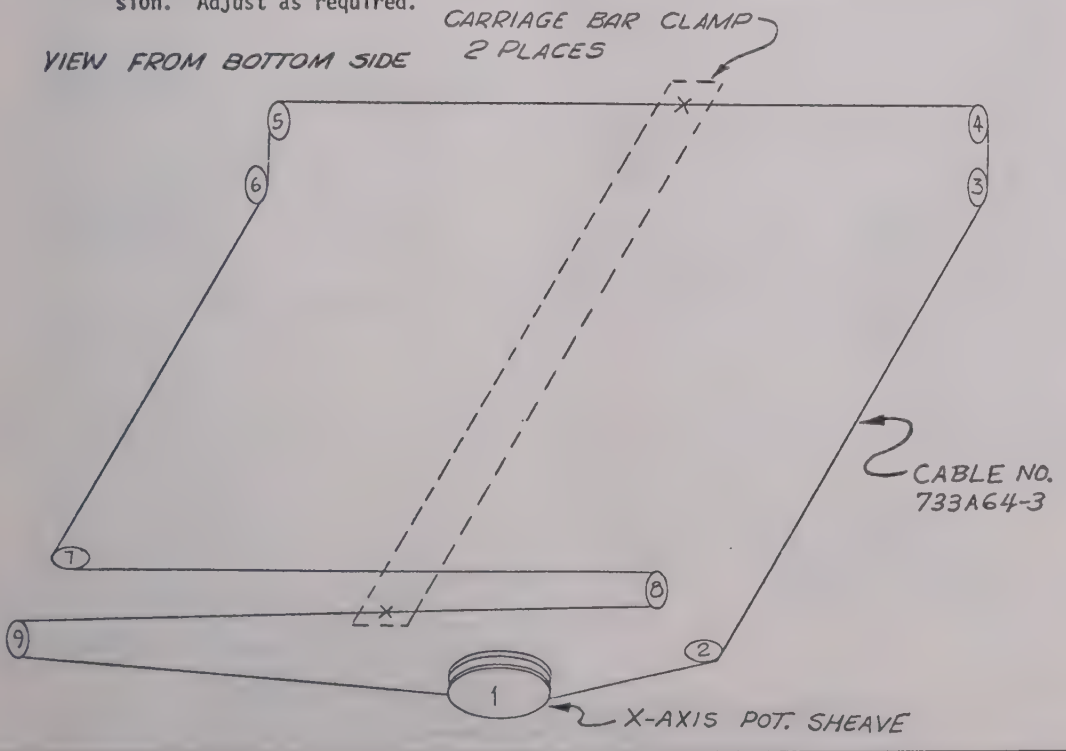
NOTE: In LAB model recorders, standard sweep rates of X-axis Time Base option listed in table are selectable by TIME BASE switch located on front panel of control module; and rate resistor R301 is not used. See Figure 6-3 in Section 6 for switch location on panel.

4.8 CABLE INSTALLATION

Two drive cables are employed to position the vertical recording system (Y-axis writing head assembly); while one drive cable moves the horizontal recording system (X-axis carriage assembly). To install new cables, refer to instructions in the stringing procedures of the following diagrams.

"X" Axis Stringing Procedure

1. Position recorder in stand,bottom side up. Pot sheave ("Y" axis) on the left hand side.
2. Rotate sheave ("X" axis) in a counterclockwise direction until pot stop is felt.
3. Pulley 2 should be assembled so that it will have full adjustment toward the right side of the recorder.
4. Tie a simple knot in one end of cable as close to the end as possible. Pass cable thru slot on the inside of the sheave, pull cable until the knot is against sheave. Wind complete turn plus a partial turn around the sheave in a counterclockwise direction with cable coming off the bottom and to pulley 2.
5. Continue stringing cable per diagram thru pulley 6. Tension must be kept on cable thru stringing operation to prevent cable from coming off of the sheave.
6. Cable must pass behind "Y" sheave to pulley 7. Continue thru 8 & 9.
7. Cable from pulley must pass behind cable between pulleys 7 & 8.
8. With the cable on the bottom side of sheave, holding end of cable, rotate "X" axis sheave in a clockwise direction until pot stop is felt. Wrap 1 complete wrap plus a partial turn, pass cable thru slot and around anchor screw. Tighten screw to retain cable and tension.
9. Check all pulleys for proper cable alignment. Proper cable tension can be obtained by changing position of pulley No. 2 toward the outside of the recorder.
10. Attach carriage bar with writing head assy. to cable using clamps on end block assy's. Adjust for zero. Carriage end blocks should contact mechanical stops before pot stops are felt.
11. With instrument vertical, move carriage back and forth a few times to insure proper carriage travel.
12. With the carriage at either zero or full scale, hang a 50 gram weight midway between pulleys 8 & 9. Cable should deflect 1/4"(±1/16") with the proper cable tension. Adjust until proper deflection can be measured.
13. Move carriage assembly back and forth a few times and remeasure cable tension. Adjust as required.



"Y" AXIS STRINGING PROCEDURE (See Diagram Below)

NOTE: "X" axis stringing should be completed first.

1. Position recorder in stand, bottom side up. "Y" axis sheave located on left-hand side.

2. With carriage assembly secured to "X" axis cable, slide writing head assembly to zero side of recorder. Keep head secured in this position by taping head to carriage assembly with piece of masking tape. Rotate "Y" axis sheave in clockwise direction until pot stop is felt.

CABLE "B" STRINGING

*3. Tie a simple knot in one end of cable "B" (59.5" long) within ¼" from end. Thread other end of cable through hole in sheave and route cable end into inside annular groove. Knotted end of cable remains on the outside of sheave.

4. Wrap 1¼ turns in a clockwise direction around inside annular groove so that cable comes off top of sheave.

5. Thread cable around pulleys 2 & 3. Rotate instrument 180° in stand (top side up).

6. Thread cable around pulleys 4, 5, and 6; and then route end of cable through hole in "B" retaining post. With cable drawn taut, secure cable end (between flat washers) by tightening hex nut.

7. Remove masking tape from writing head so that head is free to move. Rotate instrument 180° in stand (bottom side up). Rotate sheave in counterclockwise direction until pot stop is felt.

CABLE "A" STRINGING

*8. Tie a simple knot in one end of cable "A" (58" long) within ¼" from end. Thread other end of cable through hole in sheave and route cable end into the outside annular groove. Knotted end of cable remains on outside of sheave.

9. Wrap 1½ turns in a counterclockwise direction around outside annular groove so that cable comes off top of sheave.

10. Thread cable around pulleys 7 & 8. Rotate instrument 180° in stand (top side up).

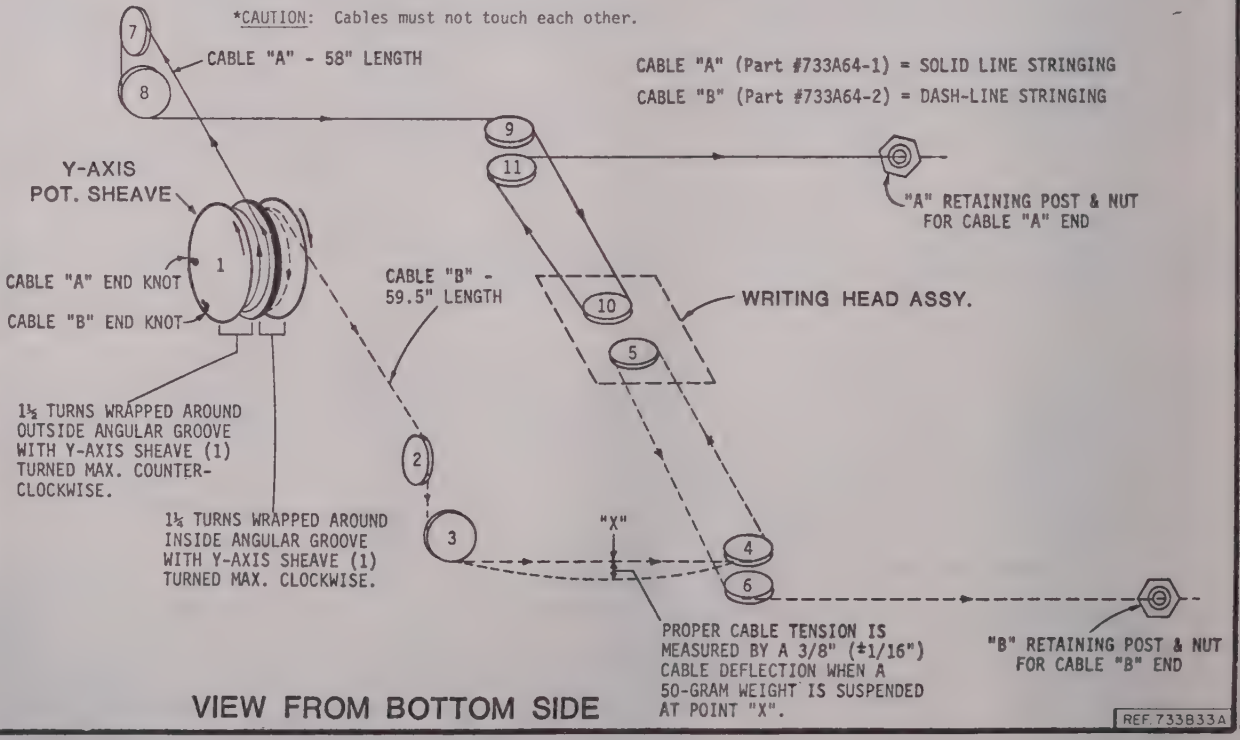
11. Thread cable around pulleys 9, 10, and 11; and then route end of cable through hole in "A" retaining post. With cable drawn taut enough to keep wrapped around sheave, secure cable end (between flat washers) by tightening hex nut.

CABLE TENSION ADJUSTMENT

12. Check all pulleys for proper cable alignment. Proper cable tension can be adjusted by loosening either cable "A" or cable "B" retaining hex nut.

13. With instrument positioned vertically and facing platen, move carriage assembly back and forth a few times to equalize cables. Leave carriage at extreme right-hand side of recorder and suspend a 50-gram weight midway between pulleys 3 and 4. Cable should deflect 3/8" (±1/16") when cable tension is correct. If proper deflection is not obtained, loosen either cable "A" or cable "B" retaining hex nut and adjust cable tension until proper deflection is measured.

14. Move writing head assembly up and down carriage bar a few times and remeasure cable tension. Adjust as required.


*CAUTION: Cables must not touch each other.
CABLE "A" - 58" LENGTH
CABLE "A" (Part #733A64-1) = SOLID LINE STRINGING
CABLE "B" (Part #733A64-2) = DASH-LINE STRINGING
Y-AXIS POT. SHEAVE
"A" RETAINING POST & NUT FOR CABLE "A" END
CABLE "A" END KNOT
CABLE "B" END KNOT
CABLE "B" - 59.5" LENGTH
WRITING HEAD ASSY.
1½ TURNS WRAPPED AROUND OUTSIDE ANGULAR GROOVE WITH Y-AXIS SHEAVE (1) TURNED MAX. COUNTER-CLOCKWISE.
1¼ TURNS WRAPPED AROUND INSIDE ANGULAR GROOVE WITH Y-AXIS SHEAVE (1) TURNED MAX. CLOCKWISE.
"X"
PROPER CABLE TENSION IS MEASURED BY A 3/8" (±1/16") CABLE DEFLECTION WHEN A 50-GRAM WEIGHT IS SUSPENDED AT POINT "X".
"B" RETAINING POST & NUT FOR CABLE "B" END
VIEW FROM BOTTOM SIDE
REF 733B33A
P1495A

4.9 SIGNAL AMPLIFIER CALIBRATION

a. Both X- and Y-axis calibration can be checked by a direct comparison with a known-accurate standard. The validity of such a test, however, depends upon the accuracy of the reference source--which should be considerably better than accuracy requirements of the recorder.

b. To check instrument calibration, zero axis pen and then apply signal from standard which is equivalent to the basic input sensitivity specified for the recording axis (or a multiple thereof). The recording pen should register the input value on the graph grid within an accuracy tolerance of ±0.25% of full graph scale.

c. If deflection sensitivity is not within desired accuracy limits, remove bottom cover from instrument and carefully adjust SPAN pot R3. This screwdriver adjustment is located on the servo amplifier PC board of each axis (see Figure 4-1). If recorder sensitivity is 100 mV/in. (or 50 mV/cm), set SPAN R3 fully clockwise and then carefully adjust CAL R21 for proper pen deflection.

> NOTE: For LAB instruments, place axis RANGE Switch in "100 mV/in" (or "50 mV/CM") position and VAR-CAL Switch in "CAL" position; set SPAN R3 fully clockwise and carefully adjust CAL R21 for proper pen deflection.

4.10 TIME BASE CALIBRATION

To calibrate the optional X-axis time base circuit, permit instrument to warm up for at least ten minutes and then proceed with the following steps:

(1) Place Sweep/Reset Switch in its "RESET" position. Short input by connecting jumper from junction of R301 and C301 to signal common on Time Base board PCB3.

> NOTE: For LAB instruments, place TIME BASE Switch in it's slowest rate position (no shorting jumper required).

(2) Connect positive lead of voltmeter to positive end of capacitor C301 and negative lead to signal common on PCB3.

(3) If voltmeter reading is not between +.001 and +.005 volts, carefully adjust BAL R309 until proper value is obtained. See Figure 4-1 for location of R309 trim pot.

> NOTE: For LAB models, see Figure 6-4 in Section 6 for location of R309.

(4) Disconnect voltmeter and shorting jumper (if previously required in Step 1). Determine sweep rate provided with instrument (see Data Sheet).

> NOTE: For LAB models, set X-axis RANGE Switch to "TB" and TIME BASE Switch to its fastest rate position.

(5) Connect crystal-controlled time marker generator to Y-axis signal input. Adjust generator's output frequency and amplitude to produce a ½-inch Y-axis deflection pulse per 1-inch travel of X-axis deflection.

NOTE: If generator is not available, an accurate stop watch may be used to time a specific sweep trace.

(6) Place Sweep/Reset Switch in its "SWEEP" position and observe time marker spacing along X-axis trace. Rate accuracy should be within 1% over full-scale deflection. After X-axis has made full-scale deflection, set Sweep/Reset Switch to "RESET" position so that X-axis trace returns to zero scale again.

NOTE: For LAB models, pulse spacing should be within ±0.5% over 14 inches of travel (36 cm). All other slower rates should be within a 1% accuracy.

(7) If sweep rate is not within acceptable tolerance, carefully adjust RATE CAL R303 until proper timing is obtained. See Figure 4-1 for location of R303 trim pot.

NOTE: For LAB models, adjust RATE CAL R315. See Figure 6-4 in Section 6 for location of R315.

(8) Repeat steps 1 through 3, disconnect voltmeter, remove shorting jumper (if used), and recheck rate accuracy as stipulated in steps 5, 6, and 7.

4.11 TROUBLESHOOTING

a. Circuit diagrams for the BASIC recorder are illustrated in Figures 4-2 and 4-3 in this section of the manual. For circuit diagrams applicable to LAB models, refer to Section 6 of manual. These diagrams provide all of the necessary information for tracing wiring and troubleshooting the electronic assemblies.

b. If trouble is indicated in one of the electrical measuring systems, the most logical troubleshooting approach is to isolate the fault to a functional area--such as: input wiring, the servo amplifier board, the feedback pot, or the servo motor. Voltage and current measurements, continuity checks, and DC resistance measurements may be necessary to pin-point the source of trouble.

CAUTION: Always turn off power before making DC continuity checks or resistance measurements.

4.12 SHUTDOWN

a. If the instrument is to remain inactive for more than 30 days, the ink cartridge should be removed and the pen tip shield placed over the pen tip. Turn off power and protect front of instrument with a suitable dust cover.

b. If the recorder is to be shut down for a brief period of time but may undergo handling vibrations, the following precautions should be taken:

NOTE: Refer to supplements with this manual for shutdown procedures regarding optional systems.

(1) Disconnect power source and all signal leads.

(2) Place shield over pen tip of ink cartridge.

(3) Tape carriage and writing head to instrument to restrict movement.

CAUTION: If instrument is to be transported for a long distance, follow factory packing procedures.

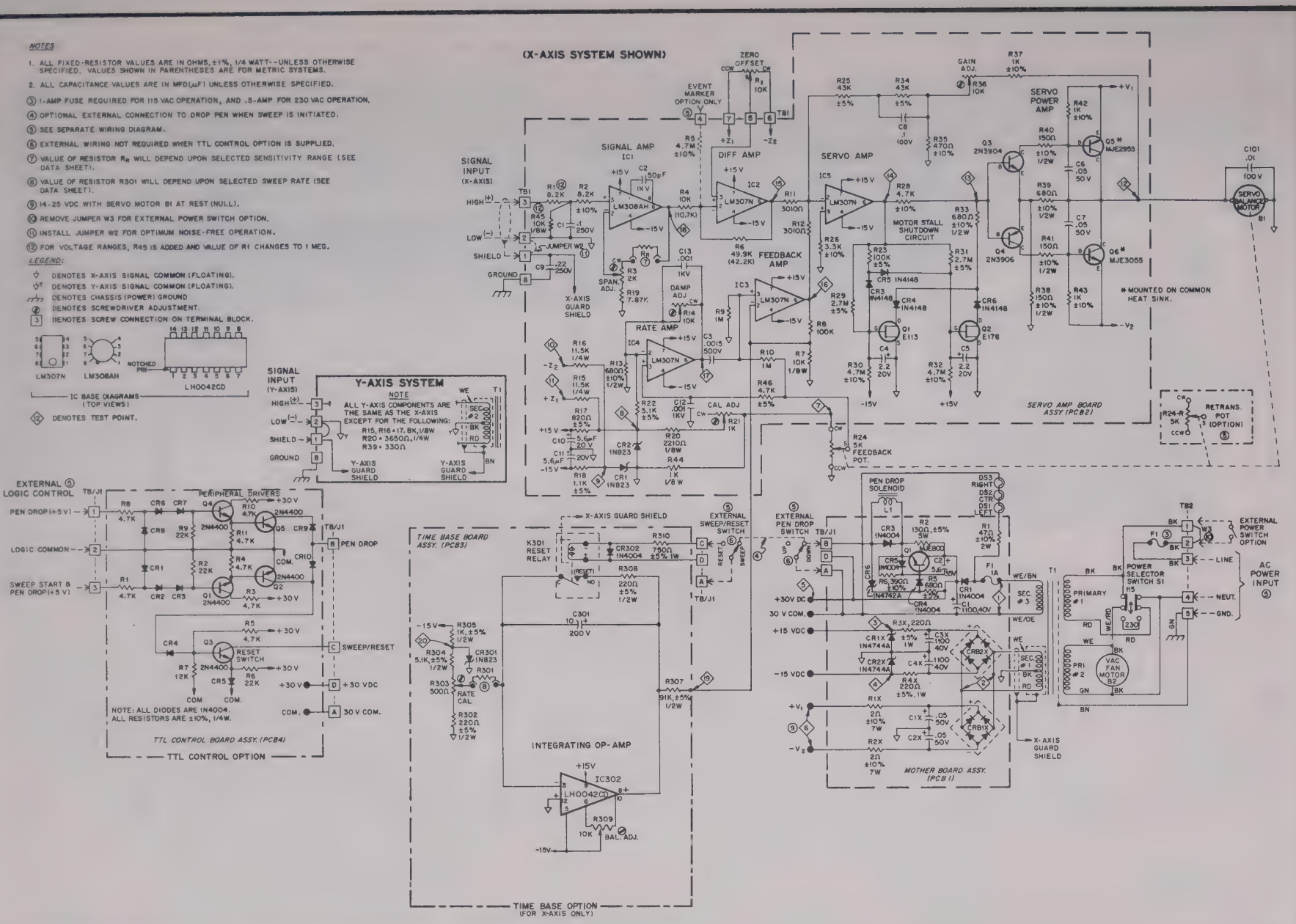

NOTES
1. ALL FIXED-RESISTOR VALUES ARE IN OHMS, ±1%, 1/4 WATT--UNLESS OTHERWISE SPECIFIED. VALUES SHOWN IN PARENTHESES ARE FOR METRIC SYSTEMS.
2. ALL CAPACITANCE VALUES ARE IN MFD(μF) UNLESS OTHERWISE SPECIFIED.
3. 1-AMP FUSE REQUIRED FOR 115 VAC OPERATION, AND .5-AMP FOR 230 VAC OPERATION.
4. OPTIONAL EXTERNAL CONNECTION TO DROP PEN WHEN SWEEP IS INITIATED.
5. SEE SEPARATE WIRING DIAGRAM.
6. EXTERNAL WIRING NOT REQUIRED WHEN TTL CONTROL OPTION IS SUPPLIED.
7. VALUE OF RESISTOR R_R WILL DEPEND UPON SELECTED SENSITIVITY RANGE (SEE DATA SHEET).
8. VALUE OF RESISTOR R301 WILL DEPEND UPON SELECTED SWEEP RATE (SEE DATA SHEET).
9. 14-26 VDC WITH SERVO MOTOR B1 AT REST (NULL).
10. REMOVE JUMPER W3 FOR EXTERNAL POWER SWITCH OPTION.
11. INSTALL JUMPER W2 FOR OPTIMUM NOISE-FREE OPERATION.
12. FOR VOLTAGE RANGES, R45 IS ADDED AND VALUE OF R1 CHANGES TO 1 MEG.
LEGEND:
DENOTES X-AXIS SIGNAL COMMON (FLOATING).
DENOTES Y-AXIS SIGNAL COMMON (FLOATING).
DENOTES CHASSIS (POWER) GROUND
DENOTES SCREWDRIVER ADJUSTMENT.
DENOTES SCREW CONNECTION ON TERMINAL BLOCK.
LM307N
LM308AH
LH0042CD
NOTCHED PIN
IC BASE DIAGRAMS (TOP VIEWS)
DENOTES TEST POINT.
(X-AXIS SYSTEM SHOWN)
ZERO OFFSET
EVENT MARKER OPTION ONLY
SIGNAL INPUT (X-AXIS)
HIGH (+)
LOW (-)
SHIELD
GROUND
JUMPER W2
SIGNAL AMP IC1
DIFF AMP
SERVO AMP
SERVO POWER AMP
GAIN ADJ.
SPAN. ADJ.
DAMP ADJ
FEEDBACK AMP
RATE AMP
MOTOR STALL SHUTDOWN CIRCUIT
X-AXIS GUARD SHIELD
SERVO AMP BOARD ASSY (PCB2)
RETRANS. POT (OPTION)
SERVO BALANCE MOTOR
*MOUNTED ON COMMON HEAT SINK.
SIGNAL INPUT (Y-AXIS)
Y-AXIS SYSTEM
NOTE
ALL Y-AXIS COMPONENTS ARE THE SAME AS THE X-AXIS EXCEPT FOR THE FOLLOWING:
R15, R16 = 17.8K, 1/8W
R20 = 3650Ω, 1/4W
R39 = 330Ω
Y-AXIS GUARD SHIELD
EXTERNAL LOGIC CONTROL
PERIPHERAL DRIVERS
PEN DROP (+5 V)
LOGIC COMMON
SWEEP START & PEN DROP (+5 V)
SWEEP/RESET
+30 VDC
30 V COM.
RESET SWITCH
NOTE: ALL DIODES ARE IN4004. ALL RESISTORS ARE ±10%, 1/4W.
TTL CONTROL BOARD ASSY. (PCB4)
TTL CONTROL OPTION
TIME BASE BOARD ASSY. (PCB3)
K301 RESET RELAY
EXTERNAL SWEEP/RESET SWITCH
INTEGRATING OP-AMP
IC302
LH0042CD
BAL. ADJ.
TIME BASE OPTION (FOR X-AXIS ONLY)
EXTERNAL PEN DROP SWITCH
PEN DROP SOLENOID
MOTHER BOARD ASSY. (PCB1)
POWER SELECTOR SWITCH S1
AC POWER INPUT
EXTERNAL POWER SWITCH OPTION
VAC FAN MOTOR B2
LINE
NEUT.
GND.
PRIMARY
SECONDARY
PR14925

Figure 4-2. Schematic Diagram for Model XY575 Basic (OEM) Recorder.

VOLTAGE CHECK TABLE FOR OEM RECORDERS

TEST POINT LOCATION(◇) IN FIG. 4-2	CHECK CONDITION REQUIREMENT	MEASUREMENT		
		"X" AXIS	"Y" AXIS	POWER SUPPLY
1	None			25V AC
2	"			35V AC
3	"			15V DC
4	"			-15V DC
5	"			30V DC
6 ($+V_1$)	Null Balance			22.7V DC
6 ($+V_1$)	Off-Null Balance			9.7V DC
6 ($-V_2$)	Null Balance			-22.8V DC
6 ($-V_2$)	Off-Null Balance			-9.4V DC
7	None	1.48V DC		
7	"		1V DC	
8	"	6.26V DC	6.26V DC	
9	"	-6.32V DC	-6.32V DC	
10	"	-1.89V DC		
10	"		-1.3V DC	
11	"	1.85V DC		
11	"		1.4V DC	
12	Null Balance	From +.8V to -.8V DC	From +.8V to -.8V DC	
12	Motor Stalled: @ Zero	-8.4V DC		
	Motor Stalled: @ Full Scale	+8.4V DC		
12	Motor Stalled: @ Zero		-7V DC	
	Motor Stalled: @ Full Scale		+7V DC	
13	Null Balance	From +1V to -1V DC	From +1V to -1V DC	
13	Motor Stalled: @ Zero	-5.6V DC	-5.6V DC	
	Motor Stalled: @ Full Scale	+5.6V DC	+5.6V DC	
14	Null Balance	From +2V to -2V DC	From +2V to -2V DC	
14	Motor Stalled: @ Zero	-13V DC	-13V DC	
	Motor Stalled: @ Full Scale	+13V DC	+13V DC	
15	Shorted Input with ZERO OFFSET Control @ Zero	0V DC	0V DC	
15	Full Scale Input	7.5V DC	5V DC (10" Deflection)	
16	Shorted Input	0V DC	0V DC	
17	Shorted Input	-8.1V DC	-8.1V DC	
17	Full Scale Input	8.7V DC	8.7V DC	
18	Shorted Input	0V DC	0V DC	
18	Full Scale Input	1.5V DC (English Version)	1V DC (English Version)	
18	Full Scale Input	1.9V DC (Metric Version)	1.15V DC (Metric Version)	
19	SWEEP/RESET Switch in RESET position.	0V DC		
19	SWEEP/RESET Switch in SWEEP position.	0 to 2.6V DC		
20	None			6.23V DC

GENERAL NOTES:

1. Measurements taken with DVM.
2. Measured values are taken from point indicated to its common return point, or as otherwise indicated.
3. Measurements apply to either English or Metric version unless otherwise specified.
4. AC input supply voltage maintained at rated value for voltage measurements.

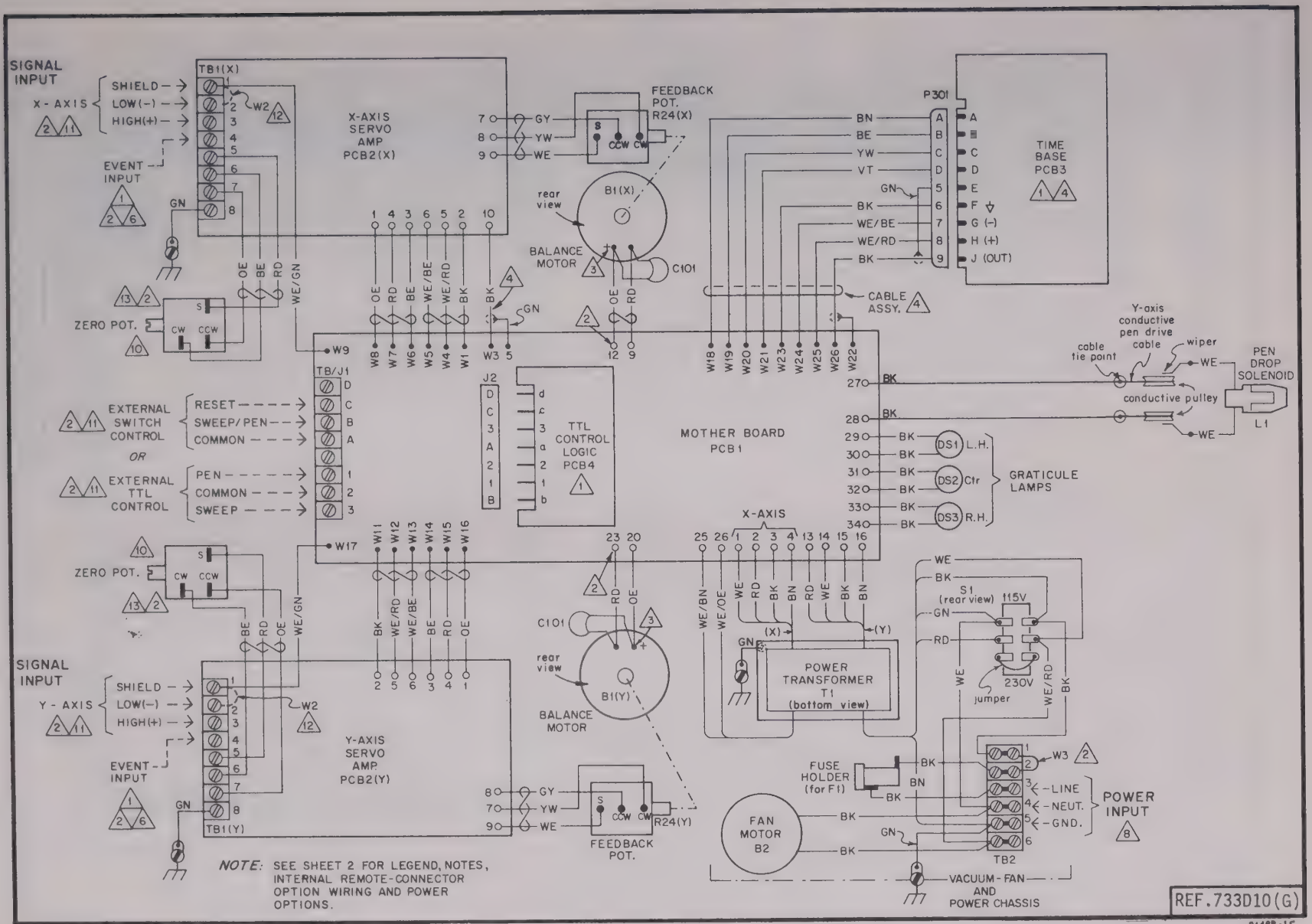


Figure 4-3. Wiring Diagram for Model XY575 Basic (OEM) Recorder (Sheet 1).

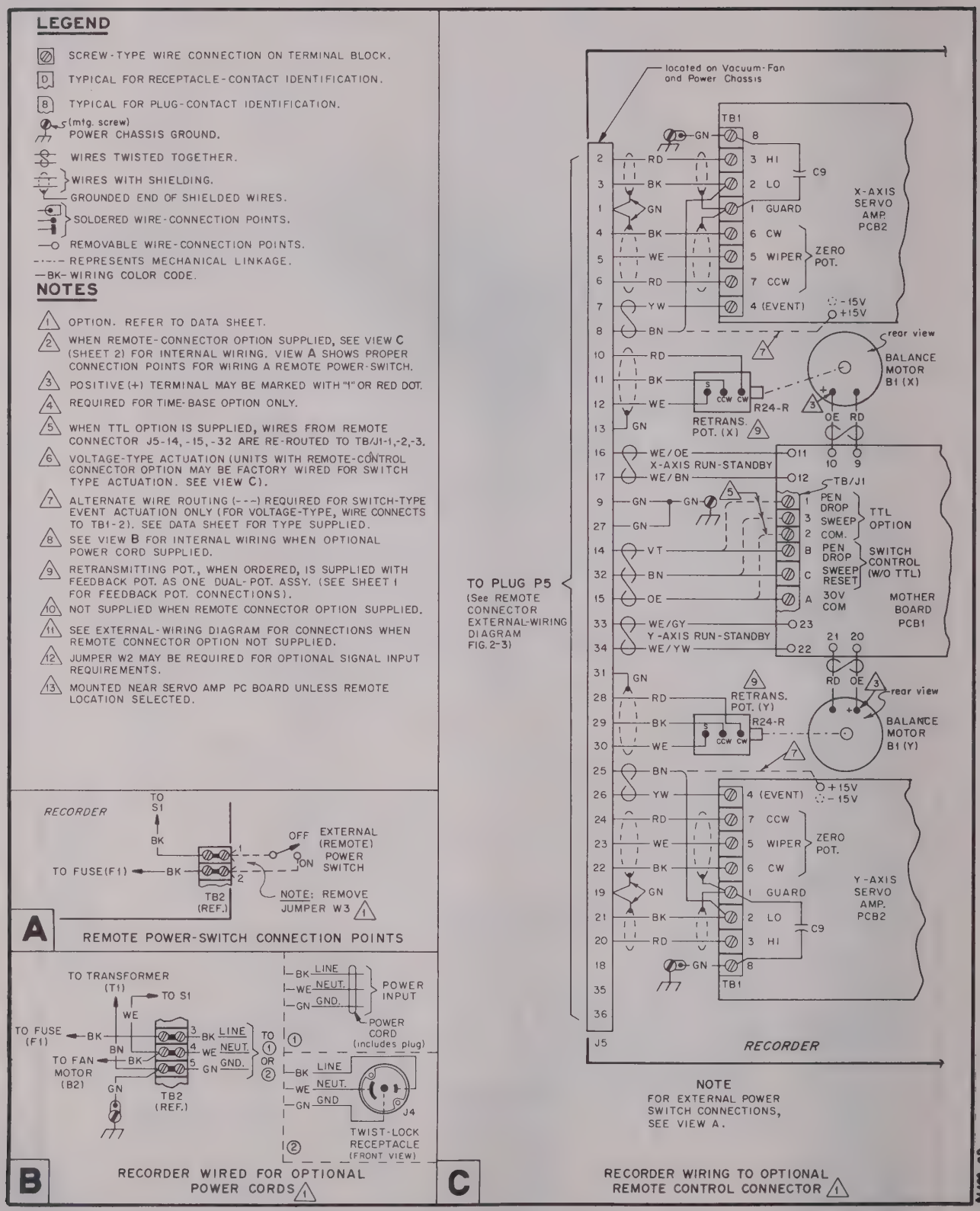

LEGEND
SCREW-TYPE WIRE CONNECTION ON TERMINAL BLOCK.
TYPICAL FOR RECEPTACLE-CONTACT IDENTIFICATION.
TYPICAL FOR PLUG-CONTACT IDENTIFICATION.
(mtg. screw) POWER CHASSIS GROUND.
WIRES TWISTED TOGETHER.
WIRES WITH SHIELDING.
GROUNDED END OF SHIELDED WIRES.
SOLDERED WIRE-CONNECTION POINTS.
REMOVABLE WIRE-CONNECTION POINTS.
REPRESENTS MECHANICAL LINKAGE.
-BK- WIRING COLOR CODE.
NOTES
1 OPTION. REFER TO DATA SHEET.
2 WHEN REMOTE-CONNECTOR OPTION SUPPLIED, SEE VIEW C (SHEET 2) FOR INTERNAL WIRING. VIEW A SHOWS PROPER CONNECTION POINTS FOR WIRING A REMOTE POWER-SWITCH.
3 POSITIVE (+) TERMINAL MAY BE MARKED WITH "1" OR RED DOT.
4 REQUIRED FOR TIME-BASE OPTION ONLY.
5 WHEN TTL OPTION IS SUPPLIED, WIRES FROM REMOTE CONNECTOR J5-14, -15, -32 ARE RE-ROUTED TO TB/J1-1,-2,-3.
6 VOLTAGE-TYPE ACTUATION (UNITS WITH REMOTE-CONTROL CONNECTOR OPTION MAY BE FACTORY WIRED FOR SWITCH TYPE ACTUATION. SEE VIEW C).
7 ALTERNATE WIRE ROUTING (- - -) REQUIRED FOR SWITCH-TYPE EVENT ACTUATION ONLY (FOR VOLTAGE-TYPE, WIRE CONNECTS TO TB1-2). SEE DATA SHEET FOR TYPE SUPPLIED.
8 SEE VIEW B FOR INTERNAL WIRING WHEN OPTIONAL POWER CORD SUPPLIED.
9 RETRANSMITTING POT., WHEN ORDERED, IS SUPPLIED WITH FEEDBACK POT. AS ONE DUAL-POT. ASSY. (SEE SHEET 1 FOR FEEDBACK POT. CONNECTIONS).
10 NOT SUPPLIED WHEN REMOTE CONNECTOR OPTION SUPPLIED.
11 SEE EXTERNAL-WIRING DIAGRAM FOR CONNECTIONS WHEN REMOTE CONNECTOR OPTION NOT SUPPLIED.
12 JUMPER W2 MAY BE REQUIRED FOR OPTIONAL SIGNAL INPUT REQUIREMENTS.
13 MOUNTED NEAR SERVO AMP PC BOARD UNLESS REMOTE LOCATION SELECTED.
RECORDER
TO S1
BK
TO FUSE(F1)
OFF
ON
EXTERNAL (REMOTE) POWER SWITCH
TB2 (REF.)
NOTE: REMOVE JUMPER W3 1
A
REMOTE POWER-SWITCH CONNECTION POINTS
TO TRANSFORMER (T1)
TO S1
WE
TO FUSE (F1)
BK
BN
TO FAN MOTOR (B2)
GN
TB2 (REF.)
LINE
NEUT.
GND.
POWER INPUT
POWER CORD (includes plug)
TO 1 OR 2
J4
TWIST-LOCK RECEPTACLE (FRONT VIEW)
B
RECORDER WIRED FOR OPTIONAL POWER CORDS 1
located on Vacuum-Fan and Power Chassis
TB1
X-AXIS SERVO AMP. PCB2
ZERO POT.
C9
R24-R
RETRANS. POT. (X) 9
BALANCE MOTOR B1 (X)
rear view
WE/OE X-AXIS RUN-STANDBY
WE/BN
TB/J1
TTL OPTION
PEN DROP
SWEEP
COM.
SWITCH CONTROL (W/O TTL)
30V COM
MOTHER BOARD PCB1
WE/GY Y-AXIS RUN-STANDBY
WE/YW
RETRANS. POT. (Y) 9
BALANCE MOTOR B1 (Y)
Y-AXIS SERVO AMP. PCB2
TO PLUG P5
(See REMOTE CONNECTOR EXTERNAL-WIRING DIAGRAM FIG. 2-3)
J5
RECORDER
NOTE
FOR EXTERNAL POWER SWITCH CONNECTIONS, SEE VIEW A.
C
RECORDER WIRING TO OPTIONAL REMOTE CONTROL CONNECTOR 1
1448-2D

Figure 4-3. Wiring Diagram for Model XY575 Basic (OEM) Recorder (Sheet 2).

ESTERLINE ANGUS INSTRUMENTATION SERVICES

TECHNICAL ASSISTANCE

Knowledgeable teams of Esterline Angus Application Engineers, Sales Engineers, and Service Engineers are always available for consultation regarding your equipment needs. When writing a Sales Office for technical assistance, be sure to include a complete description of your specific problem and both model and serial numbers of each instrument involved. Address all correspondence to your nearest Esterline Angus Sales Office (see office listing or consult local directory).

FIELD SERVICE

Esterline Angus affords the instrument purchaser an outstanding network of factory-trained Service Engineers. These individuals are highly qualified to maintain, repair, or modify instrumentation at any field installation. Contact your nearest Esterline Angus Sales Office for prompt field service (see office listing or consult local directory). Periodic Service Agreements are also available for instrument purchasers by contacting the Esterline Angus factory. Address all requests to: Service Manager, Esterline Angus Instrument Corp., Box 24000, Indianapolis, Indiana 46224.

ORDERING PARTS

When spare or replacement parts are required for an instrument, contact your nearest Esterline Angus Sales Office (see office listing or consult local directory). Furnish this authorized representative with a complete description of the part, its part number, and both model and serial numbers of the associated instrument. If all information is correctly supplied, Esterline Angus will be able to fill parts orders promptly.

RETURNING INSTRUMENTS

Should it become necessary to return an instrument to the factory, forward a purchase order or letter of explanation to: Esterline Angus Instrument Corp., Box 24000, Indianapolis, Indiana 46224. Follow instrument shutdown procedures given in the instruction manual. Pack the unit safely, mark "HANDLE WITH CARE", fully insure, and ship prepaid to: Esterline Angus Instrument Corp., 1201 Main Street, Speedway, Indiana 46224. Make sure that you include your name and return address.

WARRANTY—Only the products manufactured by the Seller and sold hereunder are warranted as free from defects of materials and workmanship and in conformance with specifications. There are no other oral, statutory, or implied warranties. Seller's obligation hereunder shall be and is limited to servicing or replacing f.o.b. its plant in Indianapolis, Indiana or such other point as Seller may designate, or refunding the purchase price of any such product manufactured by the Seller which proves to be defective in material or workmanship or which fails to conform to specifications therefor, provided that (1) written notice of such defect or failure is received by Seller from Purchaser within one year after the date of shipment of such products manufactured by the Seller, and (2) such defects, in the opinion of Seller, shall not have arisen from improper use. The absence of such written notice of defect, or failure, or lack of conformance to specifications within the specified time shall constitute a waiver of any claim. Seller may, after receipt of notice, require purchaser to send said products, transportation prepaid, to Seller for its examination and inspection.

SECTION 5 - MAIN PARTS LIST

5.1 INTRODUCTION

a. This section of the instruction manual includes complete listings of all replaceable parts which are applicable to both the BASIC and LAB versions of the Model XY575 recorder. Also included are parts listings for such options as Time Base and TTL Control Logic. Each parts list covers a major assembly or group of related components used in the construction of the instrument.

> NOTE: For parts listings which are specific to LAB models only, refer to Tables 6-1 and 6-2 in SECTION 6 of manual.

b. All parts are identified by either electrical or mechanical nomenclature in the Description column of each parts table. This column employs an indention system so that the user can determine the precise parts included in each assembly. Any assembly that is comprised of field replacement parts will have those parts indented directly below the assembly.

c. The number represented in the Qty. column of each parts table refers to the quantity used in the assembly covered under the title of each particular list. This quantity, therefore, does not necessarily reflect the total number used in the entire instrument. The term "A/R" in the quantity column listing is an abbreviation for "As Required". This term is used generally on selectable items and optional parts or for commercially-available raw materials.

5.2 LOCATING A PART NUMBER

To find a specific part number in this section of the manual, first determine the major assembly table in which the part would be found by referring to the index in paragraph 5-3; then, search down the Description column in the table until the correct description is located. Opposite that description, you will find the replacement part number. Recording supplies and accessory items will be found in the Main Assembly parts list (Table 5-1).

5.3 ORDERING INFORMATION

All parts and recording supplies are available through Esterline Angus Sales Offices. To insure prompt delivery and receipt of parts that are compatible with your specific instrument, always mention the recorder Model Number and Serial Number -- as well as the part number and description of all items requested.

INDEX TO REPLACEMENT PARTS TABLES

Subject	Table
Main Assembly	5-1
Vacuum Fan and Power Assembly	5-2
Mother Board Assembly	5-3
Servo Drive Assembly	5-4
Servo Amplifier PC Board Assembly	5-5
Time Base PC Board Assembly (Option)	5-6
Control Logic PC Board Assembly (Option)	5-7

Table 5-1. Main Assembly

Fig. 5-1 Ref. No.	Part Number	Description	Qty. Lab	Qty. Basic
--	733R3A-*	Model XY575 Recorder with Control Panel (Complete)	1	--
--	733R1A-*	Model XY575 Basic Recorder	--	1
1	733R2 ①	.Frame, Chassis	1 A/R	1 A/R
	733R4 ②	.Frame, Chassis	1 A/R	1 A/R
2	**	.Control Panel Assy.	1	--
3	733D9	.Cover, Panel Assy.	1	--
4	NX90606	.Screw, Cover Mtg. (6-32 x 3/8 Binding Head)	4	--
5	(See Table 5-2)	.Vacuum Fan and Power Assy.	1	1
6	733C4	.End-Cover, Carriage	2	2
7	733C29	.Carriage Bar Assy.	1	1
8	733B8	..Bar, Carriage	1	1
9	733A54	..Clamp, Cable	2	2
10	733A1	..Clamp, Cable	1	1
10A	733A1-1	..Clamp, Cable	1	1
11	16750313-108	..Screw (2-56 x 1/2 Flat Head)	1	1
12	HX8081-3	..Nut (No. 5-40)	2	2
13	ND40219-4	..Setscrew (No. 4-40)	1	1
14	733A77	..Stop	2	2
15	733B15A	..Carriage End-Block Assy.	2	2
16	733B3	...Block, End	1	1
17	733A10	...Pulley, Carriage	2	2
18	733A68	...Spindle	2	2
19	733B49	..Pulley and Stud Assy.	2	2
20	733A80	...Shaft, Pulley	1	1
21	733A81	...Pulley Assy.	2	2
22	733A79	...Washer, Spacer	1	1
23	733C10	..Writing Head Assy. (Complete)	1	1
24	733B48	...Housing, Writing Head	1	1
25	12581	...Washer (No. 1, Flat)	3	3
26	733B10	...Collector, Electrical	2	2
27	HX30781-3	...Screw (4-40 x 1/4 Flat Head)	2	2
28	733A73A	...Pulley, Conducting	2	2
29	733A5	...Spring, Pen	1	1
30	733C2	...Holder, Pen	1	1
31	733B1	...Pushrod, Solenoid	1	1
32	733A24	...Spring, Solenoid	1	1
33	ND40140-1	...Ring, Retaining	2	2
34(L1)	733A27	...Solenoid, Pen Drop (12V)	1	1
35	733B13	...End Cap, Housing	1	1
36	733A12	...Washer, Insulation	2	2
37	733A23	...Pin, Pivot	2	2
38	733A71	...Setscrew (Plastic)	4	4
38A	733A91	...Spacer, Stop	1	1
39	733D3A	.Platen, Writing (Standard)	1 A/R	1 A/R
39	733D4A	.Platen, Writing (Optional) A3 Size Paper Only	1 A/R	1 A/R
40	733B7	.Guide, Platen	1	1
41	733B31	.Guide, Platen	1	1
42	NX60406	.Screw (4-36 x 3/8 Fillister Head)	1	1
43†	16774972-W01	.Pen and Ink-Cartridge Assy. (6-Pack, Red)	1	1
44	733D1-2	.Cover, Bottom	1	--
44	733D1-1	.Cover, Bottom	--	1
47	733B36-4	.Screw (6-10 x 1/2 Pan Head)	8	8
48 ††	733A70	.Nut	4	4
PCB1	(See Table 5-3)	.Mother Board Assy.	1	1
49	(See Table 5-4)	.Servo Drive Assy. (Y-Axis)	1	1
50	(See Table 5-4)	.Servo Drive Assy. (X-Axis)	1	1
PCB2(Y)	(See Table 5-5)	.Servo Amplifier PC Board (Y-Axis)	1	1
PCB2(X)	(See Table 5-5)	.Servo Amplifier PC Board (X-Axis)	1	1
51	HX33002	.Grommet, Lamp	3	3
DS1-DS3	LIT22	.Lamp, Graticule	3	3
52	733B4	.Bracket, L.H. Lower Pulley	1	1
53	733B5	.Bracket, L.H. Upper Pulley	1	1
54	733A6	.Bracket, R.H. Lower Pulley	1	1
55	733A17	.Bracket, R.H. Upper Pulley	1	1
56	733A50	.Washer, Pulley	12	12
57	733A31	.Pulley Assy. (3/4")	11	11
58	733B37-1	.Screw (4-10 x 3/8 Flat Head)	11	11
59	733B36-1	.Screw (4-10 x 5/16 Pan Head)	3	3
60	733A7	.Cable Clamp & Terminal (Y-Axis)	2	2

* Refer to instrument Data Sheet for specific part number supplied.

** For parts listing of Control Panel Assembly used in LAB models, refer to Table 6-1 in Section 6 of manual.

† Supplied with Accessories. †† Part not required when 733R4 Chassis Frame (Ref. No. 1) supplied.

① Supplied on early production models. ② Supplied on later production models.

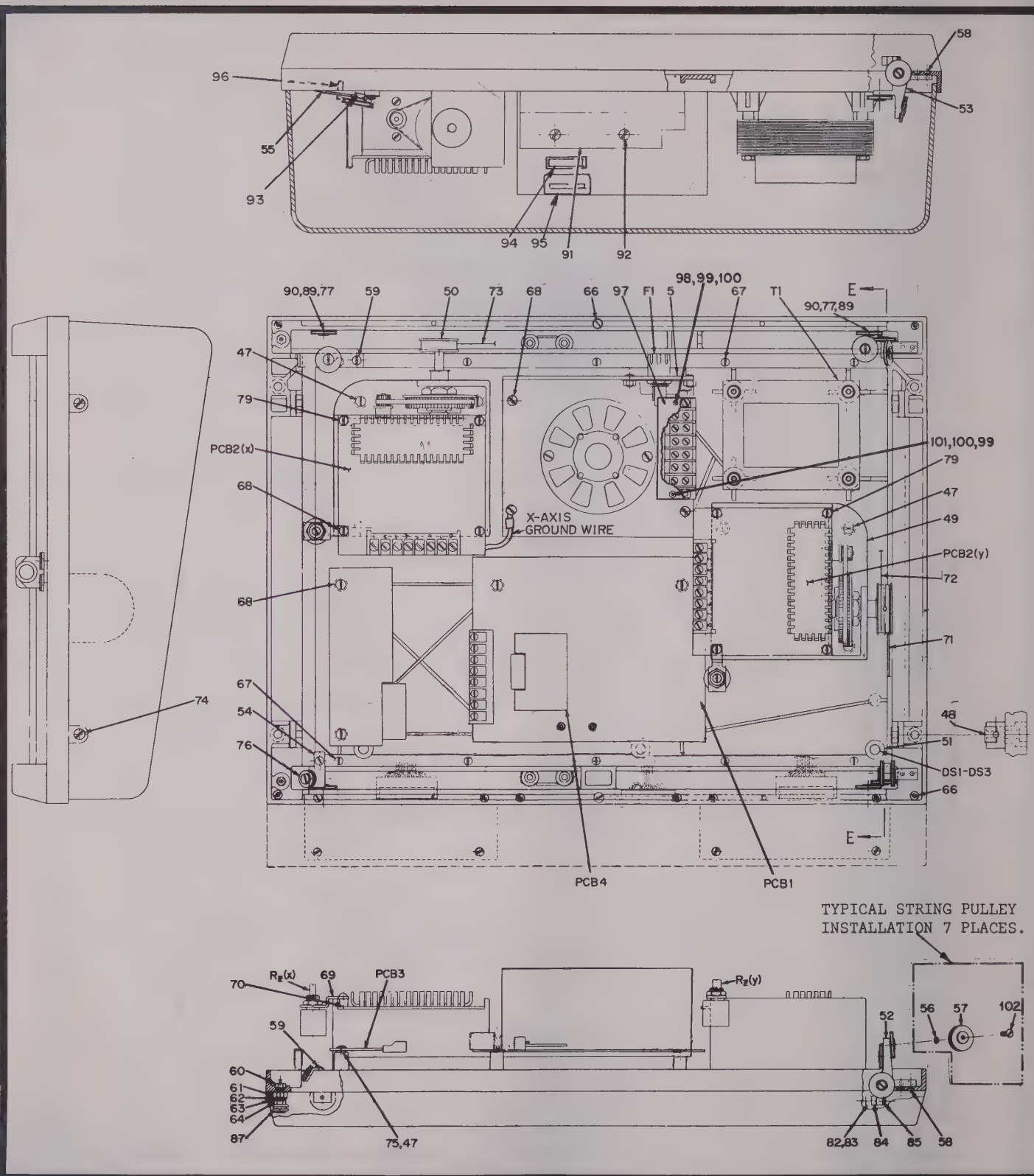


Figure 5-1 (Sheet 1 of 2). Parts Location on Main Assembly.

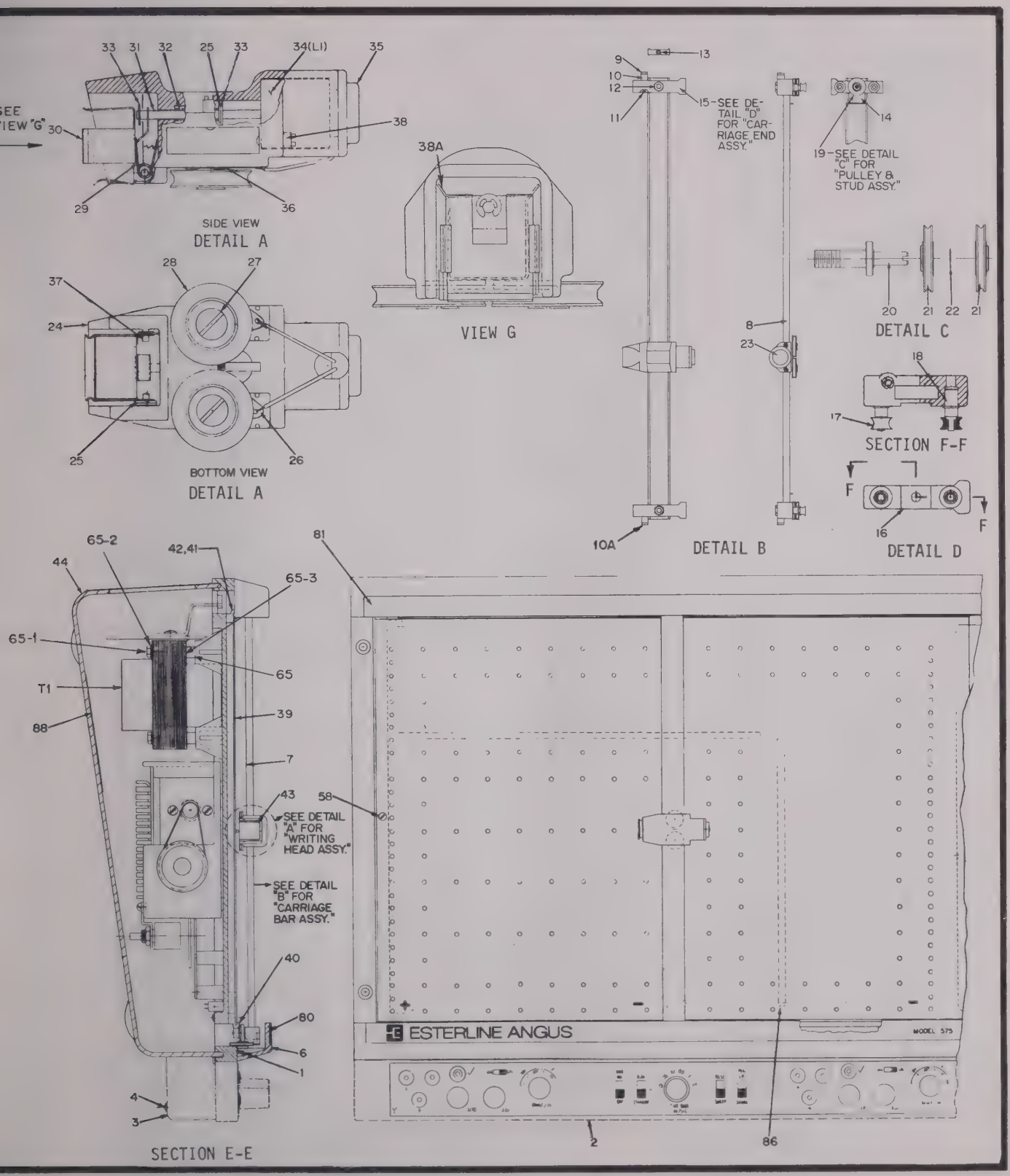


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Figure 5-1 (Sheet 2 of 2). Parts Location on Main Assembly.

Table 5-1. Main Assembly (Cont'd.).

Fig.5-1 Ref. No.	Part Number	Description	Qty. Lab	Qty. Basic
61	NX2111	.Nut (10-32 Hex)	2	2
62	NX1010	.Washer (No. 10 Plain Flat)	2	2
63	NX1006	.Washer (No. 6 Plain Flat)	2	2
64	733A58	.Nut (6-32 Hex)	2	2
T1	16800029-001	.Power Transformer Assy.	1	1
--	733D6	..Transformer, 115V/230V	1	1
65	733A92	..Spacer, Transformer Mtg.	4	4
65-1	ND40100-74	..Screw (8-32 x 1-1/2 Fillister Head)	4	4
65-2	16755674-010	..Washer, Flat	4	4
65-3	HX16309-3	..Lockwasher	4	4
66	733B36-2	.Screw (4-10 x 1/2 Pan Head)	6	6
67	NX90408	.Screw (4-36 x 1/2 Binding Head)	10	9
68	733B36-5	.Screw (6-10 x 3/4 Pan Head)	14	11
RZ(Y)§	POT85	.Potentiometer, Zero; 10K (Y-Axis)	--	1 A/R
RZ(X)§	POT85	.Potentiometer, Zero; 10K (X-Axis)	--	1 A/R
69	733A39	.Bracket, Pot. Mtg.	--	2
70	45118	.Spacer, Pot. Mtg.	--	2
71	733A64-1	.Cable, 58-inch Wire Drive (Y-Axis)	1	1
72	733A64-2	.Cable, 59.5-inch Wire Drive (Y-Axis)	1	1
73	733A64-3	.Cable, 122-inch Wire Drive (X-Axis)	1	1
74 ††	STH8C101B	.Screw (8-32 x 5/8 Pan Head)	4	4
PCB3	(See Table 5-6)Δ	.Time Base PC Board Assy. (Option)	1 A/R	1 A/R
75	50813	.Spacer, Time Base Board (Used to Mount PCB3)	--	2
PCB4	(See Table 5-7)	.TTL Logic PC Board Assy. (Option)	1 A/R	1 A/R
76	733A74	.Pulley Assy. (1/2")	1	1
77	733A49	.Spacer, Pulley	2	2
79	733B36-3	.Screw (6-10 x 3/8 Pan Head)	7	7
80	733A26	.Nameplate (Logo)	1	1
81	733A26-1	.Strip (Blank, solid black)	1	1
82	733A51	.Bumper, Carriage Stop	2	2
83	C256B8A1	.Screw (2-56 x 1/2 Binding Head)	2	2
84	11040	.Spacer	2	2
85	NX2002	.Nut, Hex (2-56)	2	2
86	01501	.Tape, Foam (19")	1	1
87	733A57-1	.Bumper, Carriage Stop	2	2
88	733A52	.Decal, Connection	1	1
■	8935G	.Cord, Attached Power (Option)	1 A/R	1 A/R
■	45068	.Cable Assy., Interlock Power (Option)	1 A/R	1 A/R
F1	14359-1	.Fuse, (1A, 250V, Slo-Blo for 115V operation)	1 A/R	1 A/R
F1	FAG2-.5	.Fuse, (.5A, 250V, Slo-Blo for 230V operation)	1 A/R	1 A/R
89	16765280-225	.Screw (4-40 x 3/8 Flat Head)	4	4
90	16103100-001	.Nut (4-40)	4	4
■	SP1904	.Washer, Lock	4	4
91	733B45	.Impeller Cover	1	1
92	NX90604	.Screw (6-32 x 1/4 Binding Head)	2	2
93	733A44	.Nut, Pulley	1	1
94	733A59	.Label, Patent	1	1
95	43097	.Label, Serial No.	1 A/R	1 A/R
96	43042	.Groov-Pin	1	1
97	733A84	.Cover, Terminal Strip	1	1
98	16765278-235	.Screw (6-32 x 7/8)	1	1
99	SP1906	.Washer, Lock (No. 6)	2	2
100	NX2006	.Nut (No. 6)	2	2
101	52594	.Standoff	1	1
102	STD440C61F	.Screw (4-40 x 3/8 Flat Head)	6	6
■	733A59	.Label, Patent	1	1
■	43097	.Decal, Serial Number (Blank, Specify Number)	1	1
■ †	16800046-001	Graph Paper (English, 11" x 17" w/.1 in. grid) ▲	A/R	A/R
■ †	16800543-001	Graph Paper (Metric, 279mm x 432mm w/mm grid) ▲	A/R	A/R
■ †	16800008-001	Graph Paper (English, 8½" x 11" w/.1 in. grid) ▲	A/R	A/R
■ †	16800009-001	Graph Paper (Metric, 216mm x 279mm w/mm grid) ▲	A/R	A/R
■	733C27	Mask, Platen (Option for small paper)	1 A/R	1 A/R
■	733A69	Accessory Kit (Option)	1 A/R	1 A/R
■	16774972-W01	.Pen and Ink-Cartridge Assy. (6-Pack, Red)	1	1
■	16800527-001	.Dust Cover	1	1
■	733C26	.Input Signal Cable Assy.	2	2
■ †	M733	Instruction Manual	1	1

† Supplied with Accessories.
§ May be supplied by user and mounted remotely.
Δ For parts listing of Time Base option used in LAB models, refer to Table 6-2 in Section 6 of manual.
■ Not illustrated.
▲ Supplied in boxes of 100 sheets.
†† Part not required when 733R4 Chassis Frame (Ref. No. 1) supplied.

Table 5-2. Vacuum Fan and Power Assembly.

Fig.5-2 Ref. No.	Part Number	Description	Qty. LAB/BASIC
--	733C6-*	Vacuum Fan and Power Assembly■	1
1	733C8	.Bracket, Mounting	1
B2	733A56▽	.Motor, Vacuum Fan	1
2	733B44▲	.Fan Impeller Assy. (with setscrew)	1
3	13048	.Spacer, Impeller Mtg.	2
4	SP1908	.Washer, Impeller Mtg. (No. 8)	4
5	ND40213-54	.Screw (8-32 x 2 1/4 Round Head)	2
S1	57534	.Switch, Power-Input Select	1
6	NX2106	.Nut (6-32 Hex)	2
7	SP1906	.Washer (No. 6)	2
8	ND40210-10	.Screw (6-32 x 3/16 Binding Head)	2
TB2	41040-6	.Terminal Block (6-Post)	1
9	41041-9	.Marker, Terminal Block	1
10	NX90606	.Screw (6-32 x 3/8 Binding Head)	1
11	ND40036-2	.Lug, Solder	1
††	43138-1	.Tie, Cable	2
12	14358	.Holder, Fuse**	1
13	14355	.Plastic Cap (Fuseholder Terminal Insulator)	1
		ASSEMBLY OPTIONS	
--	733C6-6*	.Assy. (W/O Power Cord or Remote Option)	1 A/R
--	733C6-1*	.Assy. (W/Power Cord)	1 A/R
14	43073	..Strain Relief (for Power Cord)**	1
--	733C6-2*	.Assy. (W/Power Cord & Remote Connector)	1 A/R
14	43073	..Strain Relief (for Power Cord)**	1
J5§	KBR3-40360	..Remote Connector (Receptacle)	1
15	NX90304	..Screw, Mtg. (3-48 x 1/4 Binding Head)	2
16	X2003	..Nut, Mtg. (3-48 Hex)	2
P5†	KBR3-30360	..Remote Connector (Plug; Mates with J5)	1
17	733C25-*	..Internal Cable Assy. (Remote Connector Option)	1
--	733C6-3*	.Assy. (W/Interlock Power Cable)	1 A/R
J4	45025	..Interlock Receptacle**	1
18	NX90605	..Screw, Mtg. (6-32 x 5/16 Binding Head)	2
6	NX2106	..Nut, Mtg. (6-32 Hex)	2
7	SP1906	..Washer, Mtg. (No. 6)	2
--	733C6-4*	.Assy. (W/Interlock Power Cable & Remote Connector)	1 A/R
J4	45025	..Interlock Receptacle**	1
18	NX90605	..Screw, Mtg. (6-32 x 5/16 Binding Head)	2
6	NX2106	..Nut, Mtg. (6-32 Hex)	2
7	SP1906	..Washer, Mtg. (No. 6)	2
J5§	KBR3-40360	..Remote Connector (Receptacle)	1
15	NX90304	..Screw, Mtg. (3-48 x 1/4 Binding Head)	2
16	X2003	..Nut, Mtg. (3-48 Hex)	2
P5†	KBR3-30360	..Remote Connector (Plug)	1
17	733C25-*	..Internal Cable Assy. (Remote Connector Option)	1
--	733C6-5*	.Assy. (W/Remote Connector)	1 A/R
J5§	KBR3-40360	..Remote Connector (Receptacle)	1
15	NX90304	..Screw, Mtg. (3-48 x 1/4 Binding Head)	2
16	X2003	..Nut, Mtg. (3-48 Hex)	2
P5†	KBR3-30360	..Remote Connector (Plug)	1
17	733C25-*	..Internal Cable Assy. (Remote Connector Option)	1

* Refer to Instrument Data Sheet for specific assembly number supplied.
** See Table 5-1 for Power Cord (or Interlock Cable option) and fuse part numbers.
† Supplied with accessories.
†† Not illustrated.
▽ Will require No. 733B44 impeller assembly if original is not mounted by setscrew.
▲ If original impeller is not mounted by setscrew, carefully break from motor shaft without damaging shaft.
■ See Table 5-1 for impeller cover part number.
§ Part of remote internal cable assembly (Item 17).

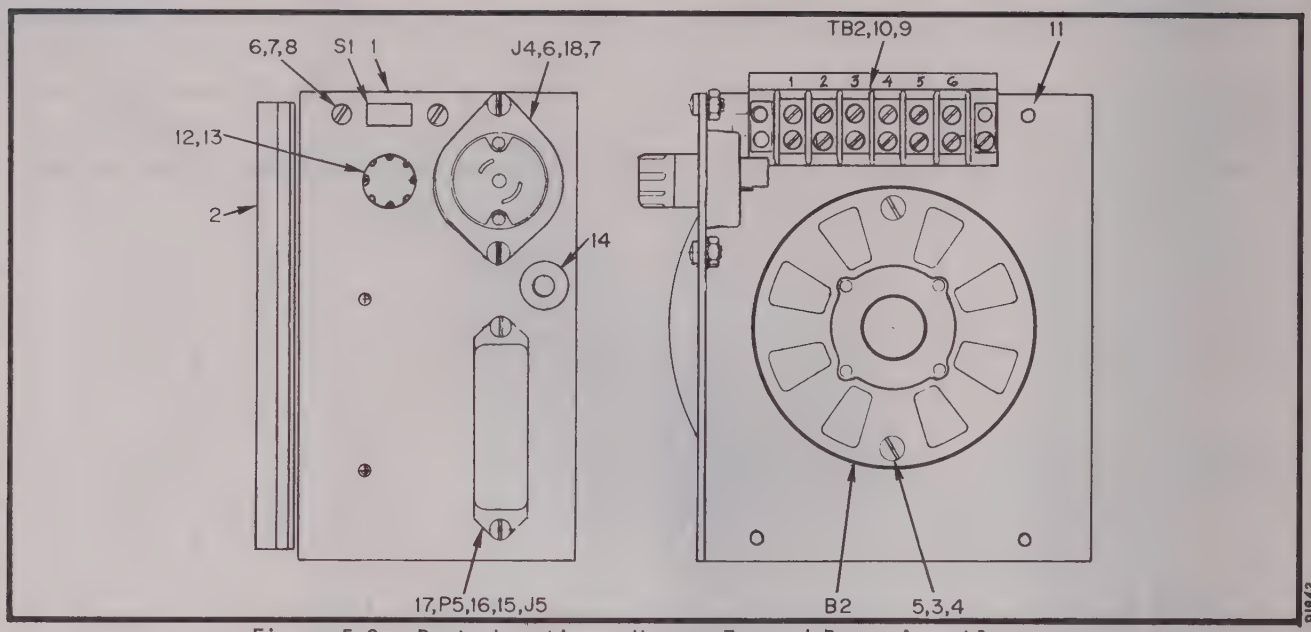

Figure 5-2. Parts Location — Vacuum Fan and Power Assembly.

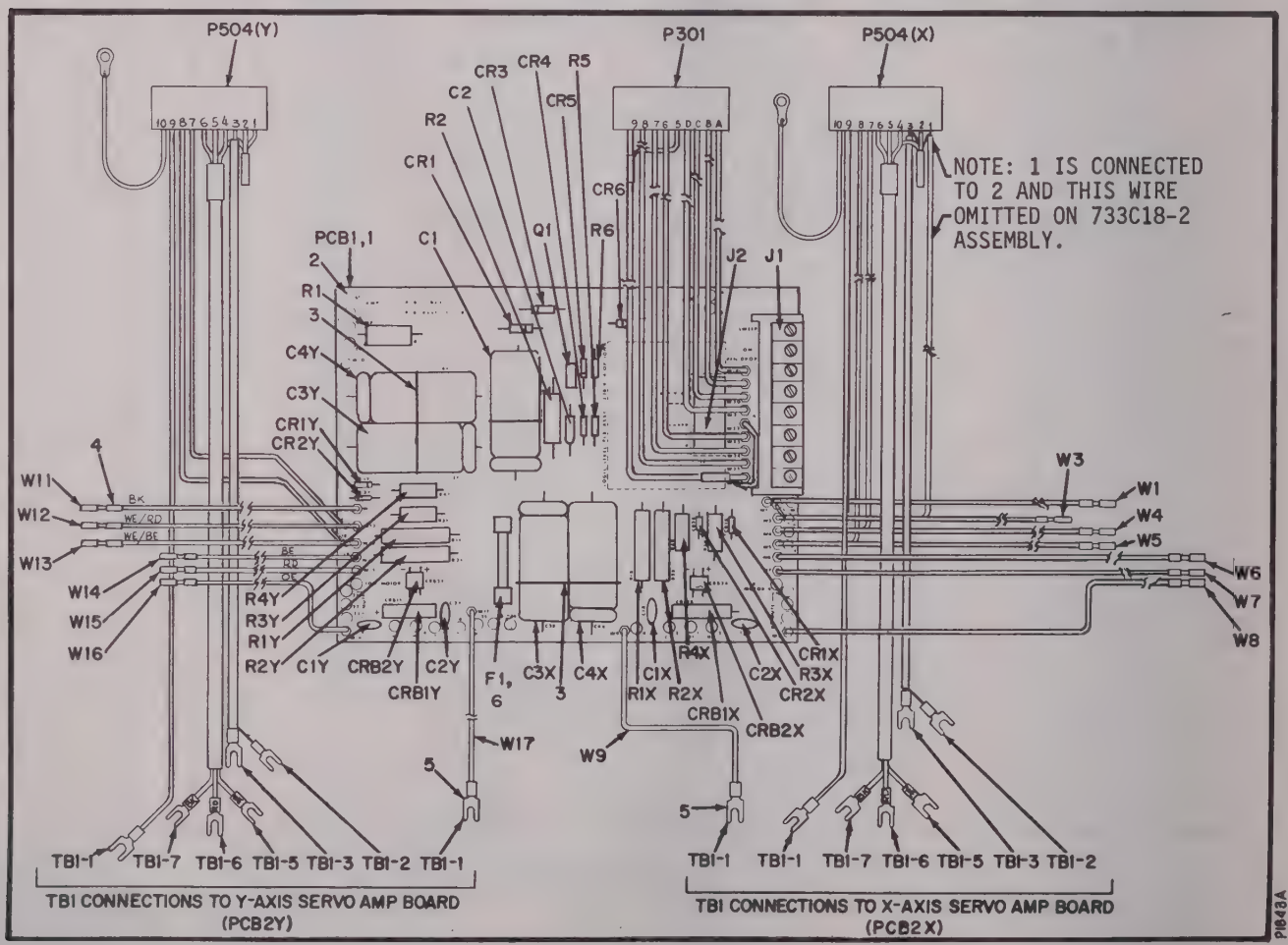

Figure 5-3. Parts Location — Mother Board Assembly.

Table 5-3. Mother Board Assembly.

Fig. 5-3 Ref. No.	Part Number	Description	Qty. LAB	Qty. BASIC
PCB1	733C18-†	Mother Board Assy. (Complete)	1	1
1	733B22	.PC Board (Less Parts)	1	1
2	KPC21M	.Connector, Terminal Post (Male)	27	27
3	16755973-003	.Tie (Rubber)	3	3
4	KPC21F	.Connector, Wire (Female)	11	11
5	ND40034-2	.Lug, Wire Terminal	2	2
C1,C3X, C3Y,C4X, C4Y	CEL120	.Capacitor, Electrolytic; 1100µF, 40V	5	5
C2	43129-9	.Capacitor, Electrolytic; 5.6µF, 35V	1	1
C1X,C1Y, C2X,C2Y	CDC23	.Capacitor, Disc; 0.05µF, 50V	4	4
CR1,CR3	43421	.Diode; 1N4004	2	2
CR1X,Y, CR2X,Y	67A15	.Diode, Zener; 1N4744A	4	4
CR4,CR5	43421	.Diode, 1N4004	2	2
CR6	52147-2	.Diode, Zener; 1N4742A	1	1
CRB1X,Y	DIR960	.Rectifier Assy., Diode Bridge	2	2
CRB2X,Y	14127-1	.Rectifier Assy., Diode Bridge	2	2
J1	KPC56	.Terminal Block (8-Post)	1	1
J2	KPC57	.Connector, 7-Pin (For TTL Logic Option)	1	1
P301	733B23	.Cable Assy. (For Time Base Option)	1	1
P504(Y)	733B35	.Cable Assy., Preamp (Y-Axis)	1	-
P504(X)	733B30	.Cable Assy., Preamp (X-Axis, w/Time Base Option)	1	-
P504(X)	733B30-1	.Cable Assy., Preamp (X-Axis, w/o Time Base Option)	1	-
Q1	TRAMJE800	.Transistor; MJE800	1	1
R1	RCC8-470	.Resistor, C.C.; 47Ω, ±10%, 2W	1	1
R2	RWW20-131	.Resistor, W.W.;130Ω, ±5%, 5W	1	1
R1X,Y, R2X,Y	RWW32-208	.Resistor, W.W.; 2Ω, ±10%, 7W	4	4
R5	RCC10-681	.Resistor, C.C.; 680Ω, ±5%, 1/4W	1	1
R6	RCC11-391	.Resistor, C.C.; 390Ω, ±10%, 1/4W	1	1
R3X,Y, R4X,Y	RCC4-221	.Resistor, C.C.; 220Ω, ±5%, 1W	4	4
W1	0768	.Wire, Black (8" Lg.)	1	1
W3	01006	.Wire, Shield (5" Lg.; For Time Base Option)	-	1
W4	0792	.Wire, White/Red (5½" Lg.)	1	1
W5	0787	.Wire, White/Blue (5½" Lg.)	1	1
W6	0772	.Wire, Blue (8" Lg.)	1	1
W7	0769	.Wire, Red (8" Lg.)	1	1
W8	0771	.Wire, Orange (8" Lg.)	1	1
W9	0788	.Wire, White/Green (6" Lg.)	1	1
W11	0768	.Wire, Black (7" Lg.)	1	1
W12	0792	.Wire, White/Red (5" Lg.)	1	1
W13	0787	.Wire, White/Blue (5" Lg.)	1	1
W14	0772	.Wire, Blue (6" Lg.)	1	1
W15	0769	.Wire, Red (6" Lg.)	1	1
W16	0771	.Wire, Orange (6" Lg.)	1	1
W17	0788	.Wire, White/Green (4" Lg.)	1	1
6	HOL-1-9	.Holder, Fuse	2	2
F1	14359-1	.Fuse; 1A, 250V, SLO-BLO	1	1

† Refer to Instrument Data Sheet for Specific Part Number Supplied.

Table 5-4. Servo Drive Assembly.

Fig. 5-4 Ref. No.	Part Number	Description	Qty.* LAB / BASIC
--	733C9-1	Servo Assy., X-Axis (Complete)	1
--	733C9-2	Servo Assy., Y-Axis (Complete)	1
1	733C5	.Housing	1
2	43119	.Lockwasher	1
B1	733B12	.Motor, Servo (12V)	1
3	733A9	.Pulley, Belt; 75 Tooth	1
4	733A19	.Pulley, Motor;14 Tooth (Y-Axis)	1
	733A20	.Pulley, Motor; 10 Tooth (X-Axis)	1
5	733A13	.Nut, Clutch	1
6	ND40140-8	.Ring, Retaining	2
7	70A199-5	.Belt, Servo Drive; 89 Tooth	1
8	NX90608	.Screw, Binding Head; 6-32 x 1/2	2
9	STH440E51F	.Screw, Type "F" Pan Head; 4-40 x 5/16 (Y-Axis)	1
	ND40102-53	.Screw, Round Head, 2-56 x 3/8 (X-Axis)	1
10	733B6	.Sheave, Y-Axis	1
	733B11	.Sheave, X-Axis	1
11	733A47-1	.Shaft, Servo (X-Axis)	1
	733A47-2	.Shaft, Servo (Y- Axis)	1
12	HX20593	.Setscrew; 4-40 x 1/4	1
13	733A25	.Bearing, Servo Shaft	2
14	733A48	.Coupler, Shaft	1
15	733A4	.Bracket, Anti-rotation	1
16	ND40219-4	.Setscrew; 4-40 x 3/16	1
17	733B61	.X-Axis Ground Wire Assy.	1
C101	CDC28	.Capacitor, Disc; 0.01µF, 100V	1
R24†	733A32	.Potentiometer, Feedback; 5K, ±5%	1
R24, R24-R	733B42	.Potentiometer, Feedback w/Retrans. (Option); 5K each	1 A/R

* Quantity shown represents total required per assembly. Two assemblies are required per instrument--one for X-Axis and one for Y-Axis.

† Part of retransmitting pot. option (when option supplied).

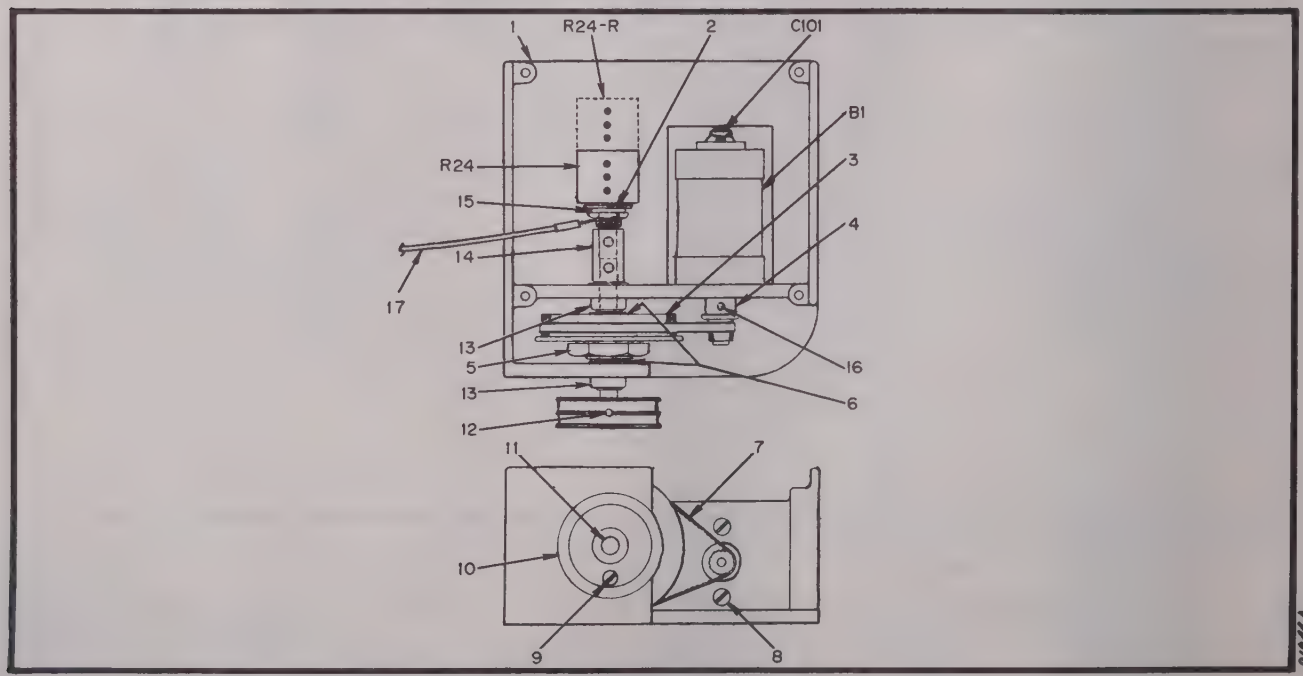

Figure 5-4. Parts Location—Servo Drive Assembly.

Table 5-5. Servo Amplifier PC Board Assembly.

Fig.5-5 Ref. No.	Part Number	Description	Qty.* LAB/BASIC
PCB2X	733B47-†	Servo Amp Assy., X-Axis (English) Complete	1 A/R
		Servo Amp Assy., X-Axis (Metric) Complete	1 A/R
PCB2Y	733B47-†	Servo Amp Assy., Y-Axis (English) Complete	1 A/R
		Servo Amp Assy., Y-Axis (Metric) Complete	1 A/R
1	733B47-2	.PC Board (Less Parts)	1
2	KPC21M	.Connector, Terminal Post (Male)	15
3	DIS-UP10-1	.Heat Sink, Transistor	1
4	ND40123-5	.Nut, Pem	2
5	NX1106	.Washer (Flat)	2
6	NX90608	.Screw (6-32 x 1/2)	2
7	WAG6AE**	.Washer (Wave)	2
C1	CMM39	.Capacitor; Disc; 0.1µF, 250V	1 A/R■
C2	40763-3	.Capacitor, Disc; 50pF, 1KV	1
C3	CMM84	.Capacitor, Molded; 0.0015µF, ±5%	1
C4,C5	CEL146	.Capacitor, 2.2µF, ±20%, 20V	2
C6,C7	CDC23	.Capacitor, Disc; 0.05µF, 50V	2
C8	CDC6	.Capacitor, Disc; .1µF, 100V	1
C9	CMM52	.Capacitor, Molded; 0.22µF, 250V	1
C10,C11	CEL80	.Capacitor, Electrolytic; 5.6µF, 25V	2
C12,C13	CDC44	.Capacitor, Disc; .001µF, 1000V	2
CR1,CR2	43125	.Diode, Zener; 1N823	2
CR3-CR6	DIO4148	.Diode; 1N4148	4
IC1	OPA308A	.Op-Amp; LM308AH	1
IC2-IC5	OPA307N	.Op-Amp; LM307N	4
Q1	FET-J113	.Transistor; FET (E113)	1
Q2	FET-J176	.Transistor; FET (E176)	1
Q3	TRA3904	.Transistor; 2N3904	1
Q4	43210	.Transistor; 2N3906	1
Q5	733B50Δ	.Transistor; MJE2955	1
Q6		.Transistor; MJE3055	1
R1¶	RCC11-822	.Resistor, C.C.; 8.2K, ±10%, 1/4W	1
R2	RCC11-822	.Resistor, C.C.; 8.2K, ±10%, 1/4W	1
R3	PPC64	.Potentiometer; 2K (SPAN)	1
R4	RMF15-10001	.Resistor, M.F.; 10K, ±1%, 1/8W (English)	1 A/R
R4	RMF15-10701	.Resistor, M.F.; 10.7K, ±1%, 1/8W (Metric)	1 A/R
R5θ	RCC11-475	.Resistor, C.C.; 4.7MEG, ±10%, 1/4W	1 A/R
R6	RMF31-49901	.Resistor, M.F.; 49.9K, ±1%, 1/4W (English)	1 A/R
R6	RMF15-42201	.Resistor, M.F.; 42.2K, ±1%, 1/8W (Metric)	1 A/R
R7	RMF15-10001	.Resistor, M.F.; 10K, ±1%, 1/8W	1
R8	RMF4-10002	.Resistor, M.F.; 100K, ±1%, 1/4W	1
R9,R10	RMF4-10003	.Resistor, M.F.; 1MEG, ±1%, 1/4W	2
R11,R12	RMF31-30100	.Resistor, M.F.; 3010Ω, ±1%, 1/4W	2
R13,R33	RCC2-681	.Resistor, C.C.; 680Ω, ±10%, 1/2W	2
R14	PPC65	.Potentiometer; 10K (DAMP)	1
R36	POT86	.Potentiometer; 10K (GAIN)	1
R15,R16	RMF4-11501	.Resistor, M.F.; 11.5K, ±1%, 1/4W (X-Axis only)	2 A/R
	RMF15-17801	.Resistor, M.F.; 17.8K, ±1%, 1/8W (Y-Axis only)	2 A/R
R17	RCC10-821	.Resistor, C.C.; 820Ω, ±5%, 1/4W	1
R18	RCC10-112	.Resistor, C.C.; 1100Ω, ±5%, 1/4W	1
R19	RMF15-78700	.Resistor, M.F.; 7870Ω, ±1%, 1/8W	1
R20	52123-1	.Resistor; 2210Ω, ±1%, 1/8W (X-Axis only)	1 A/R
	RMF4-36500	.Resistor, M.F.; 3650Ω, ±1%, 1/4W (Y-Axis only)	1 A/R
R21	PPC63	.Potentiometer; 1K (CAL.)	1
R22	RCC10-512	.Resistor, C.C.; 5.1K, ±5%, 1/4W	1
R23	RCC10-104	.Resistor, C.C.; 100K, ±5%, 1/4W	1

† Refer to instrument Data Sheet for specific part number supplied.
* Quantity shown represents total required per PC board. Two PC boards are required per instrument--one for X-axis and one for Y-axis.
** Furnished with transistor.
■ Required in BASIC model only.
¶ On voltage ranges in BASIC models only, R1 Part Number becomes RMF4-10003 (M.F.; 1MEG, ±1%, 1/4W); and R45 is also required.
θ Required for Event Marker option only.
Δ Matched pair.

Table 5-5. Servo Amplifier PC Board Assembly (Cont'd.)

Fig.5-5 Ref. No.	Part Number	Description	Qty.* LAB/BASIC
R25,R34	RCC10-433	.Resistor, C.C.; 43K, ±5%, 1/4W	2
R26	RCC11-332	.Resistor, C.C.; 3.3K, ±10%, 1/4W	1
R28	RCC11-472	.Resistor, C.C.; 4.7K, ±10%, 1/4W	1
R29,R31	RCC10-275	.Resistor, C.C.; 2.7MEG, ±5%, 1/4W	2
R30,R32	RCC11-475	.Resistor, C.C.; 4.7MEG, ±10%, 1/4W	2
R35	RCC11-471	.Resistor, C.C.; 470Ω, ±10%, 1/4W	1
R37,R42, R43	RCC11-102	.Resistor, C.C.; 1K, ±10%, 1/4W	3
R38,R40, R41	RCC2-151	.Resistor, C.C.; 150Ω, ±10%, 1/2W	3
R39	RCC2-681	.Resistor, C.C.; 680Ω, ±10%, 1/2W (X-Axis)	1 A/R
	RCC2-331	.Resistor, C.C.; 330Ω, ±10%, 1/2W (Y-Axis)	1 A/R
R44	RMF15-1000	.Resistor, M.F.; 1K, ±1%, 1/8W	1
R45¶	RMF15-10001	.Resistor, M.F.; 10K, ±1%, 1/8W	1 A/R
R46	RCC10-472	.Resistor, C.C.; 4.7K, ±5%, 1/4W	1
R_R	†	.Resistance, Range (Specify)	A/R
TB1	KPC56	.Terminal Block (8-Posts)	1

* Quantity shown represents total required per PC board. Two PC boards are required per instrument--one for X-axis and one for Y-axis.

¶ On voltage ranges in BASIC models only, R1 Part Number becomes RMF4-10003 (M.F.; 1 MEG, ±1%, 1/4W); and R45 is also required.

† Refer to instrument Data Sheet for specific part number supplied.

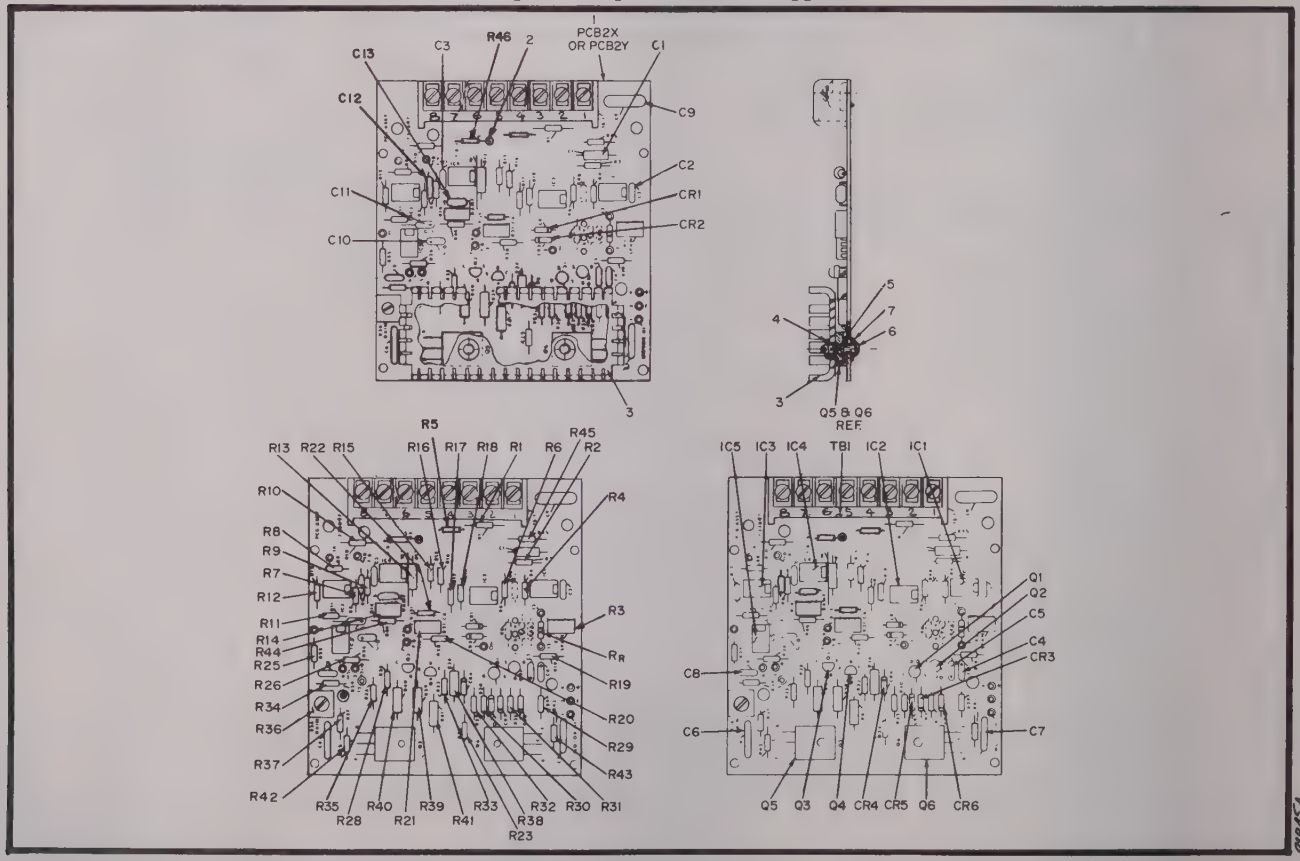

Figure 5-5. Parts Location — Servo Amplifier PC Board Assembly.

Table 5-6. Time Base PC Board Assembly (Option); Basic Models Only.

Fig. 5-6 Ref. No.	Part Number	Description	Qty.
PCB3	733B20	PC Board Assy., Fixed Rate (Complete)	1
1	733B21	.PC Board (Less Parts)	1
C301	16800058-001	.Capacitor, Mylar Film; 10µF, 200V	1
CR301	43125	.Diode, Zener; 1N823	1
CR302	43421	.Diode, 1N4004	1
IC301†	ICT2005	.Op-Amp; HA2-2005	1
IC302*	OPA307N	.Op-Amp; LM307N	1
K301	REL17	.Relay, Reset	1
R301	**	.Resistor, Rate	1
R302	RCC1-221	.Resistor, C.C.; 220Ω, ±5%, 1/2W	1
R303	PPC25	.Pot, Trim; 500Ω (RATE CAL)	1
R304	RCC1-512	.Resistor, C.C.; 5.1K, ±5%, 1/2W	1
R305	RCC1-102	.Resistor, C.C.; 1K, ±5%, 1/2W	1
R307	RCC1-913	.Resistor, C.C.; 91K, ±5%, 1/2W	1
R308	RCC1-221	.Resistor, C.C.; 220Ω, ±5%, 1/2W	1
R309Δ	PPC11	.Pot, Trim; 100K (RATE BAL)	1
R310	RCC4-751	.Resistor, C.C.; 750Ω, ±5%, 1W	1
W301	01066	.Wire, Jumper (22-GA)	A/R
LINK 1	0512	.Wire, Jumper (24-GA)	A/R

† IC301 deleted in later production units.
* IC302 becomes Op-Amp Type LH0042CD (Part No. OPA42) in later production units.
Δ R309 value changed to 10K (Part No. PPC12) in later production units.
** Refer to instrument Data Sheet for specific part number supplied.

Table 5-7. Control Logic PC Board Assembly (Option).

Fig. 5-7 Ref. No.	Part Number	Description	Qty. LAB/BASIC
PCB4	733B19-4	TTL Control Logic PCB Assy. (Complete)	1 A/R
1	732B19-1	.PC Board (Less Parts)	1
2	KPC58	.Connector, Board Pin	7
CR1-CR10	43421	.Diode; 1N4004	10
Q1-Q5	45362	.Transistor; 2N4400	5
R1,R3-R5, R8,R10,R11	RCC11-472	.Resistor, C.C.; 4.7K, ±10%, 1/4W	7
R2,R6,R9	RCC10-223	.Resistor, C.C.; 22K, ±5%, 1/4W	3
R7	RCC10-123	.Resistor, C.C.; 12K, ±5%, 1/4W	1

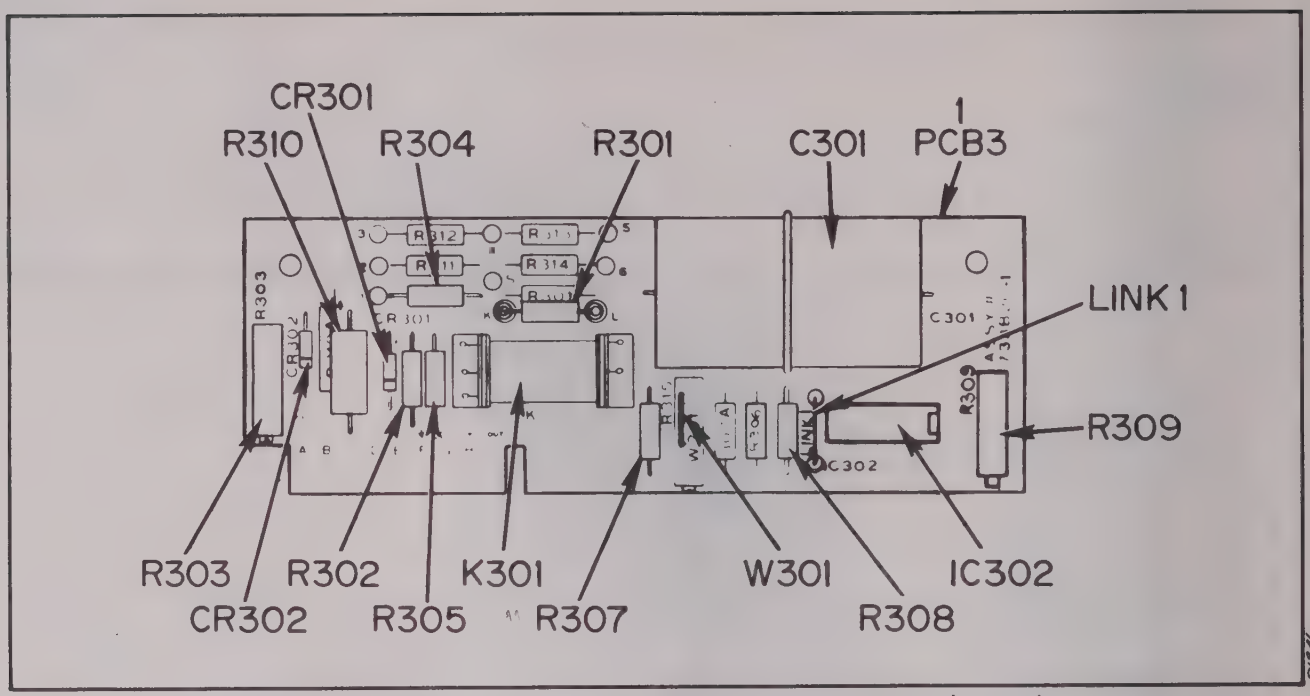

Figure 5-6. Parts Location—Time Base PC Board Assembly (Option).

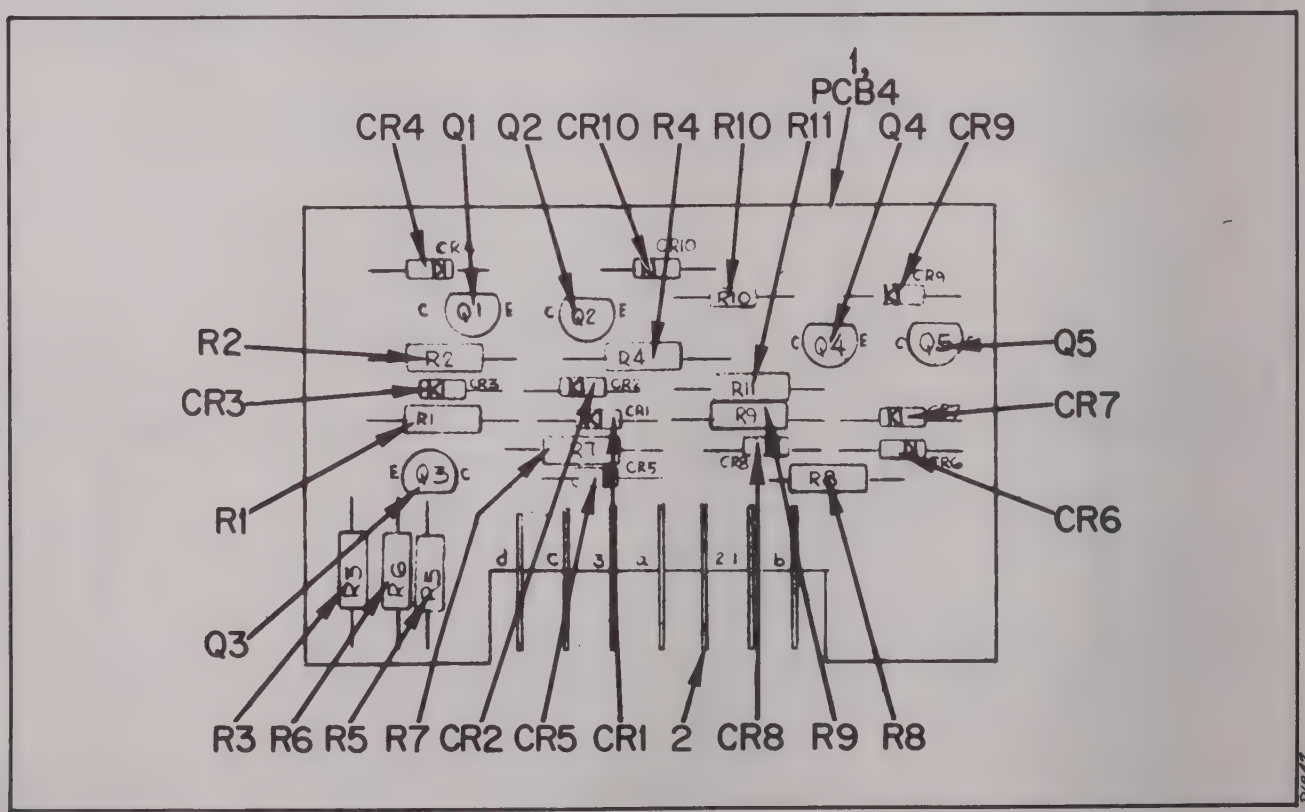

Figure 5-7. Parts Location—Control Logic PC Board Assembly (Option).

SECTION 6— SUPPLEMENTAL INSTRUCTIONS FOR MODEL XY575—LAB RECORDER

6.1 INTRODUCTION

An X-Y Spartan recorder supplied with the Control Module is similar to the BASIC Model XY575 except for the addition of a front-panel attachment. This attachment includes signal input jacks and complete operating controls for both X and Y axes. The Control Module provides multi-range measurements and is available with or without X-axis Time Base features. Refer to information in this section for LAB model design details. Refer to SECTIONS 1 through 5 of manual for appropriate information applicable to both LAB and BASIC models.

6.2 SPECIFICATIONS

NOTE: For BASIC instrument specifications, refer to page iii in front of manual.

Acceleration: 1500 in/sec/sec, minimum (38 m/sec/sec) both axes.
Accuracy: ±0.25% of full scale.
Common mode rejection: 130 dB at DC.
Common mode voltages: 200 VDC to ground and between channels.
Deadband: ±0.1% of full scale.
Feedback potentiometer: conductive plastic, infinite resolution.
Function switch: Two positions, selected calibrated span as switch, or variable, with ADJ pot.
Input configuration: Floating, single ended.
Input impedance: Essentially infinite on 1, 10, and 100 mV/in or 0.5, 5, and 50 mV/cm ranges; 1 megohm on 1 and 10 V/in or 0.5 and 5 V/cm ranges.
Input terminals: High, low, and ground, triangular layout.
Internal adjustments: Servo gain, damping and variable sensitivity controls on each axis.
Multi-range selector switch (on each axis): 1 mV/in, 10 mV/in, 100 mV/in, 1 V/in, 10 V/in, or 0.5 mV/cm, 5 mV/cm, 50 mV/cm, 0.5 V/cm, and 5 V/cm.
Overshoot: 1% of full scale, maximum.
Paper size: 11" H x 17" W (279 mm x 432 mm). Optional A3 size is 300 mm H x 420 mm W.
Pen drop control: Labeled PEN UP and DOWN. Remote operation optional at cyclic rates above 45/sec.
Power cord: 6 ft (1.8 m) three-wire cord with strain-relief hardware.
Power requirements: 115 V or 230 V ±10%, 60 Hz, standard, 48-62 Hz rating optional.
Power switch: Labeled OFF and ON.
Repeatability: ±0.1% of full scale.
Size: 19" x 15¾" x 6" (483 mm x 400 mm x 152 mm)
Slewing speed: 45 in/sec (1143 mm/sec) or faster.
Span vernier: Multi-turn ADJ pot with range of more than 10/1 attenuation.
Standby switch: Labeled RUN-STANDBY. In STANDBY. mode, both servo motors are de-activated.
Step response: 0.3 sec for 10 in (250 mm), both axes.
Temperature range (ambient) for rated conditions: 23°± 5°C.
Temperature range (operating): 10° to 40°C.
Weight: 16 lbs (7.3 kg).
Zero check pushbutton: Momentary contact switch (each axis) causes pen to go to electrical zero.
Zero controls: 10 turn control with ±100% of span adjustability (each axis).

OPTION SPECIFICATIONS

Event marker input (option): External switch or DC voltage causes pen deflection. Both X and Y axes available. Deflection = 0.1 inch per 5 VDC. Input impedance = 1 megohm, minimum. Internal 15 VDC supply for external switch operation.
Power rating (universal): Provides for 115 or 230 v (±10%) and 48 to 62 Hz power sources.
Remote connector: Provides quick-connect of variety of signal and control functions. Typical functions are pen drop, sweep control, event marker input, analog signal inputs. (See "How to Order" section for details.)
Retransmitting potentiometers (either axis): Conductive plastic, 5000 ohms ±10%. 10 VDC maximum excitation, 1 mA maximum wiper current.
Time base: 6 switch-selectable sweep speeds 0.01, 0.05, 0.1, 0.5, 1 and 2 in/sec or 0.2, 1, 2, 10, 20, and 40 mm/sec. Sweep control switch, labeled RESET—SWEEP. Time base accuracy ±2% over operating range.
TTL logic input control functions: Provides 5 VDC TTL level control of pen drop and sweep control, as applicable.
Grid mask: Provides optimum vacuum hold-down for 8½" x 11" (215mm x 279mm) paper, when installed over vacuum grid.
Accessories (standard):
One package of six ink cartridges, one package of 100 sheets of graph paper, one operating and maintenance manual.
Accessory kit (optional): Includes one package of six red ink cartridges, one recorder dust cover, and two signal input cables with plug terminals.

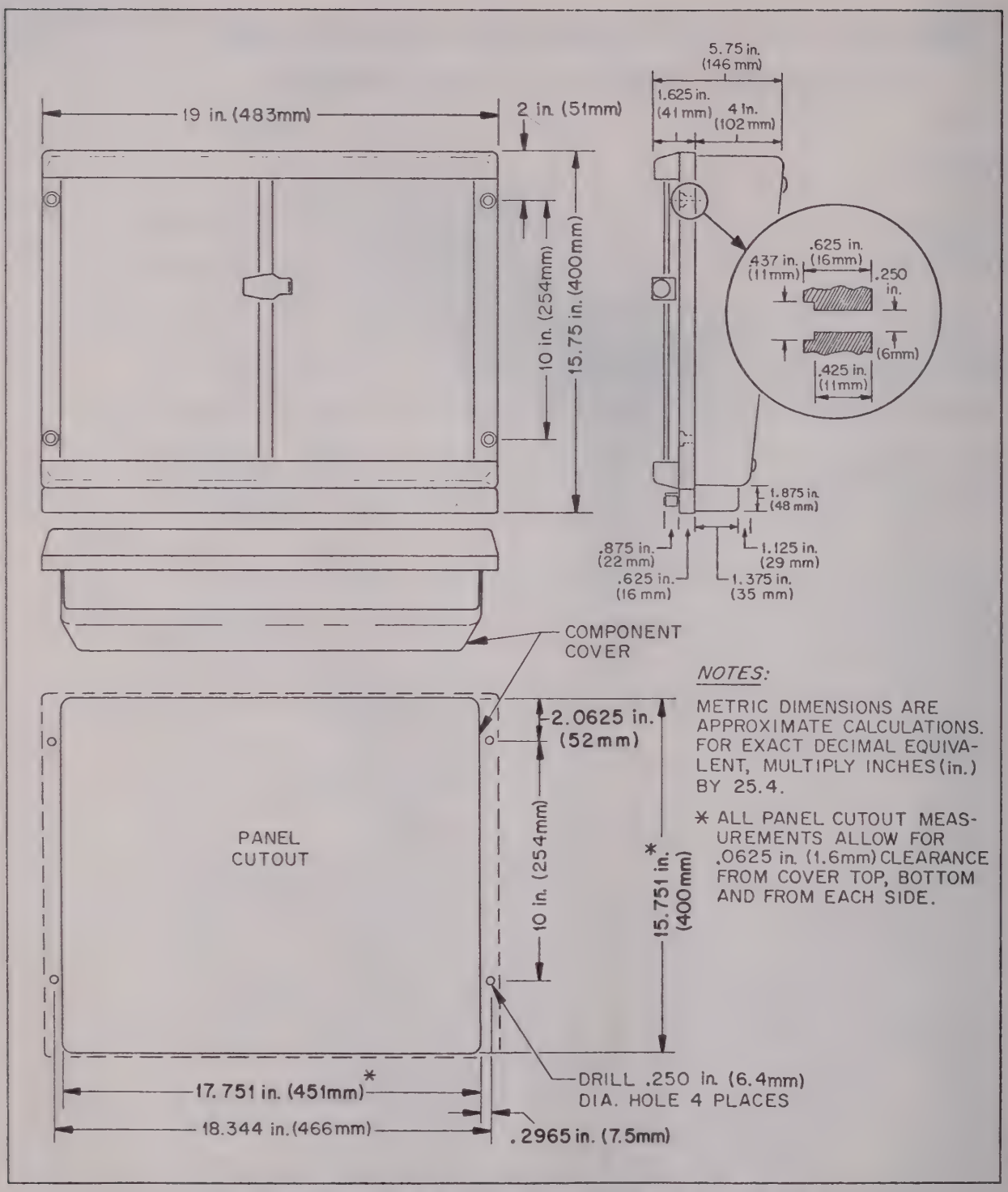
19 in. (483mm)
2 in. (51mm)
10 in. (254mm)
15.75 in. (400mm)
5.75 in. (146 mm)
1.625 in. (41 mm)
4 in. (102 mm)
.625 in. (16mm)
.437 in. (11mm)
.250 in.
(6mm)
.425 in. (11mm)
1.875 in. (48 mm)
.875 in. (22 mm)
.625 in. (16 mm)
1.125 in. (29 mm)
1.375 in. (35 mm)
COMPONENT COVER
PANEL CUTOUT
2.0625 in. (52mm)
10 in. (254mm)
15.751 in.* (400mm)
17.751 in. (451mm)*
18.344 in. (466mm)
DRILL .250 in. (6.4mm) DIA. HOLE 4 PLACES
.2965 in. (7.5mm)
NOTES:
METRIC DIMENSIONS ARE APPROXIMATE CALCULATIONS. FOR EXACT DECIMAL EQUIVALENT, MULTIPLY INCHES (in.) BY 25.4.
* ALL PANEL CUTOUT MEASUREMENTS ALLOW FOR .0625 in. (1.6mm) CLEARANCE FROM COVER TOP, BOTTOM AND FROM EACH SIDE.
P1436A

Figure 6-1. Installation and Dimension Diagram for LAB Model Recorders.

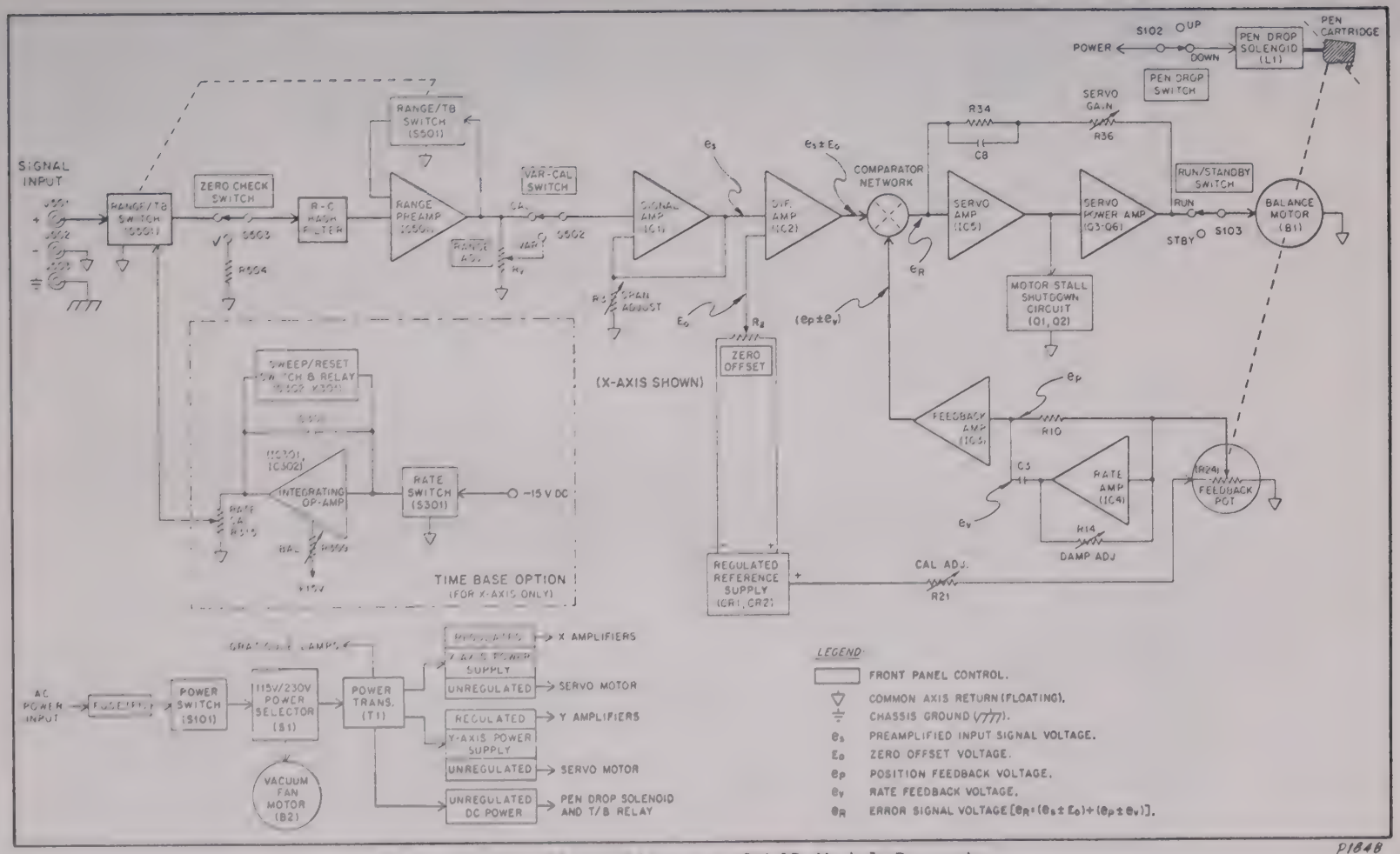

Figure 6-2. Block Diagram of LAB Model Recorder.

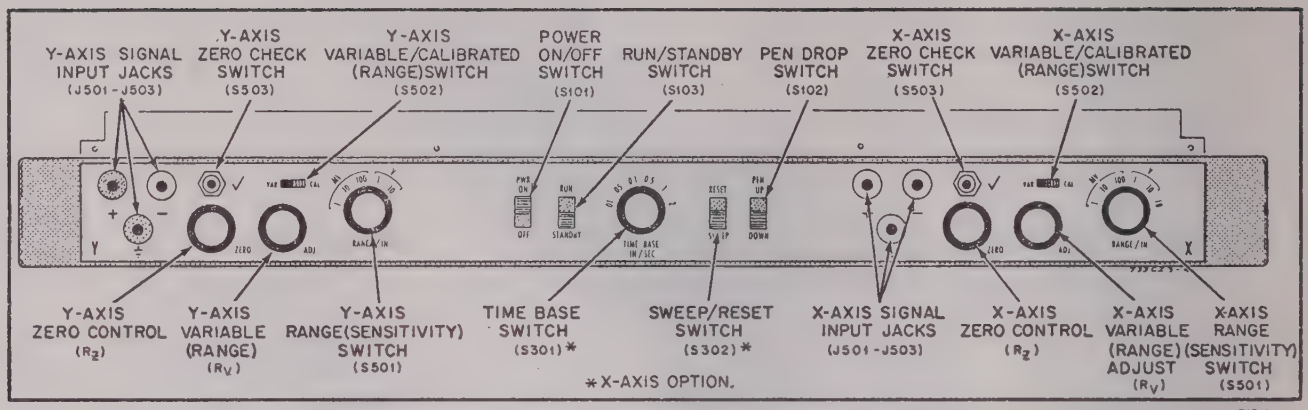

Figure 6-3. Front Panel of Control Module.

NOTE: For calibrated sensitivities and time base rates, place VAR/CAL switch in its "CAL" position. Refer to Figure 2-3 for remote operation.

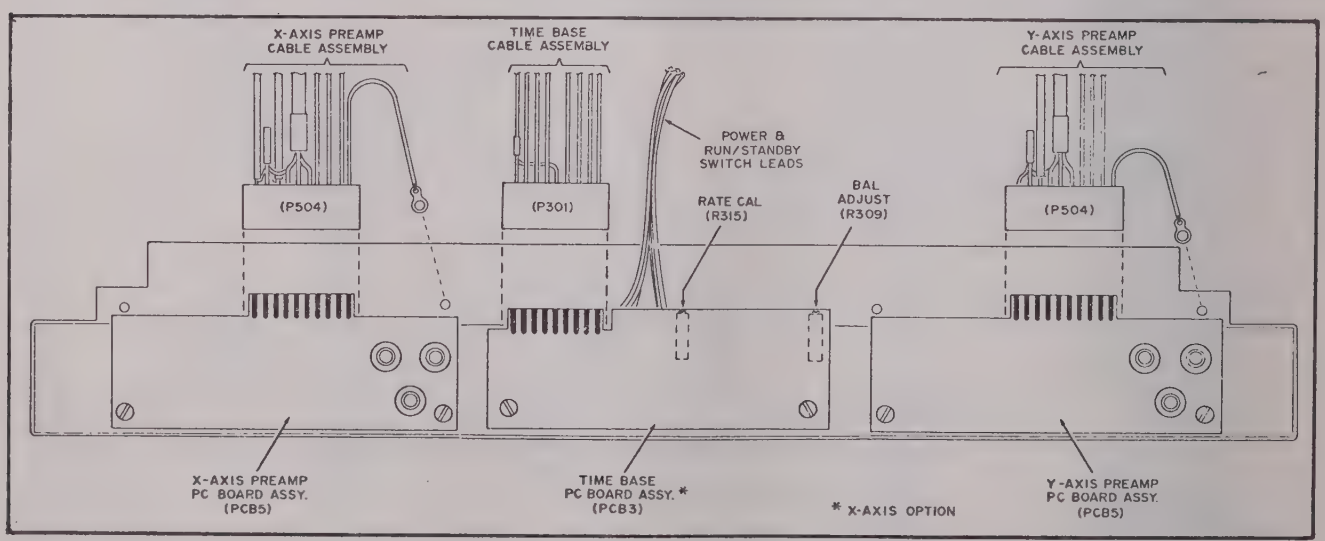

Figure 6-4. Rear View of Control Module with Cover Removed.

6.3 CIRCUIT DIAGRAMS

a. The schematics and wiring diagrams contained in this section of manual are reflective only of LAB model recorders. For circuit diagrams covering BASIC (OEM) models, refer to SECTION 4 of manual.

b. Refer to these diagrams for tracing of wiring and for troubleshooting the electronic assemblies.

6.4 SUPPLEMENTAL PARTS LIST

a. The parts listings contained in this section of manual apply only to those parts which are specific to the LAB model recorders.

b. For parts which are applicable to both the BASIC and LAB versions, refer to main parts list section (SECTION 5) of manual.

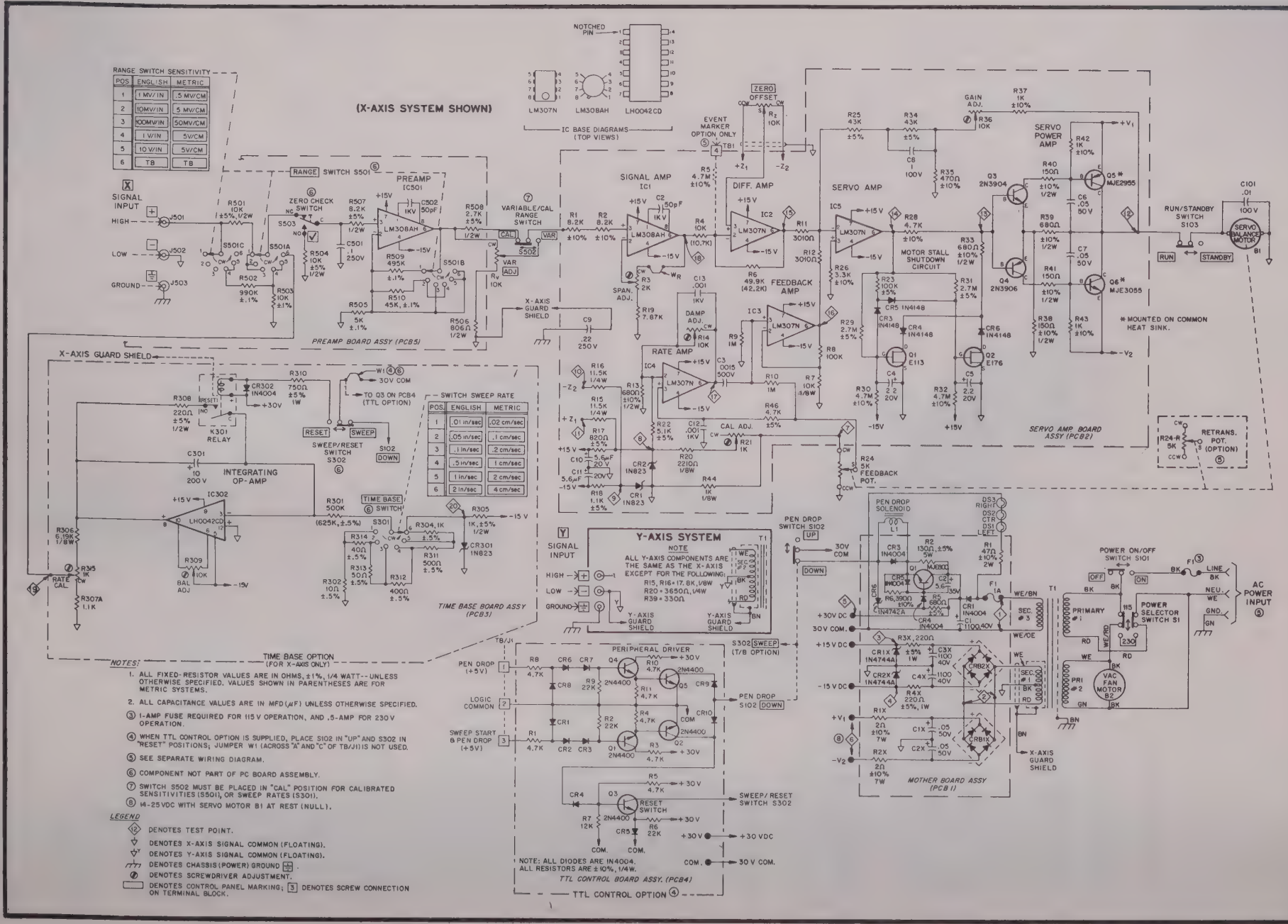

Figure 6-5. Schematic Diagram for Model XY575-Lab Recorder.

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VOLTAGE CHECK TABLE FOR LAB RECORDERS

TEST POINT LOCATION(◇) IN FIG. 6-5	CHECK CONDITION REQUIREMENT	MEASUREMENT		
		"X" AXIS	"Y" AXIS	POWER SUPPLY
1	None			25V AC
2	"			35V AC
3	"			15V DC
4	"			-15V DC
5	"			30V DC
6 ($+V_1$)	Null Balance			22.7V DC
6 ($+V_1$)	Off-Null Balance			9.7V DC
6 ($-V_2$)	Null Balance			-22.8V DC
6 ($-V_2$)	Off-Null Balance			-9.4V DC
7	None	1.48V DC		
7	"		1V DC	
8	"	6.26V DC	6.26V DC	
9	"	-6.32V DC	-6.32V DC	
10	"	-1.89V DC		
10	"		-1.3V DC	
11	"	1.85V DC		
11	"		1.4V DC	
12	Null Balance	From +.8V to -.8V DC	From +.8V to -.8V DC	
12	Motor Stalled: @ Zero	-8.4V DC		
12	Motor Stalled: @ Full Scale	+8.4V DC	-7V DC	
13	Null Balance	From +1V to -1V DC	From +1V to -1V DC	
13	Motor Stalled: @ Zero	-5.6V DC	-5.6V DC	
13	Motor Stalled: @ Full Scale	+5.6V DC	+5.6V DC	
14	Null Balance	From +2V to -2V DC	From +2V to -2V DC	
14	Motor Stalled: @ Zero	-13V DC	-13V DC	
14	Motor Stalled: @ Full Scale	+13V DC	+13V DC	
15	Shorted Input with ZERO OFFSET Control @ Zero	0V DC	0V DC	
15	Full Scale Input	7.5V DC	5V DC (10" Deflection)	
16	Shorted Input	0V DC	0V DC	
17	Shorted Input	-8.1V DC	-8.1V DC	
17	Full Scale Input	8.7V DC	8.7V DC	
18	Shorted Input	0V DC	0V DC	
18	Full Scale Input	1.5V DC (English Version)	1V DC (English Version)	
18	Full Scale Input	1.9V DC (Metric Version)	1.15V DC (Metric Version)	
19	SWEEP/RESET Switch in RESET position.	0V DC		
19	SWEEP/RESET Switch in SWEEP position.	0 to 2.6V DC		
20	None			6.23V DC

GENERAL NOTES:

1. Measurements taken with DVM.
2. Measured values are taken from point indicated to its common return point, or as otherwise indicated.
3. Measurements apply to either English or Metric version unless otherwise specified.
4. AC input supply voltage maintained at rated value for voltage measurements.

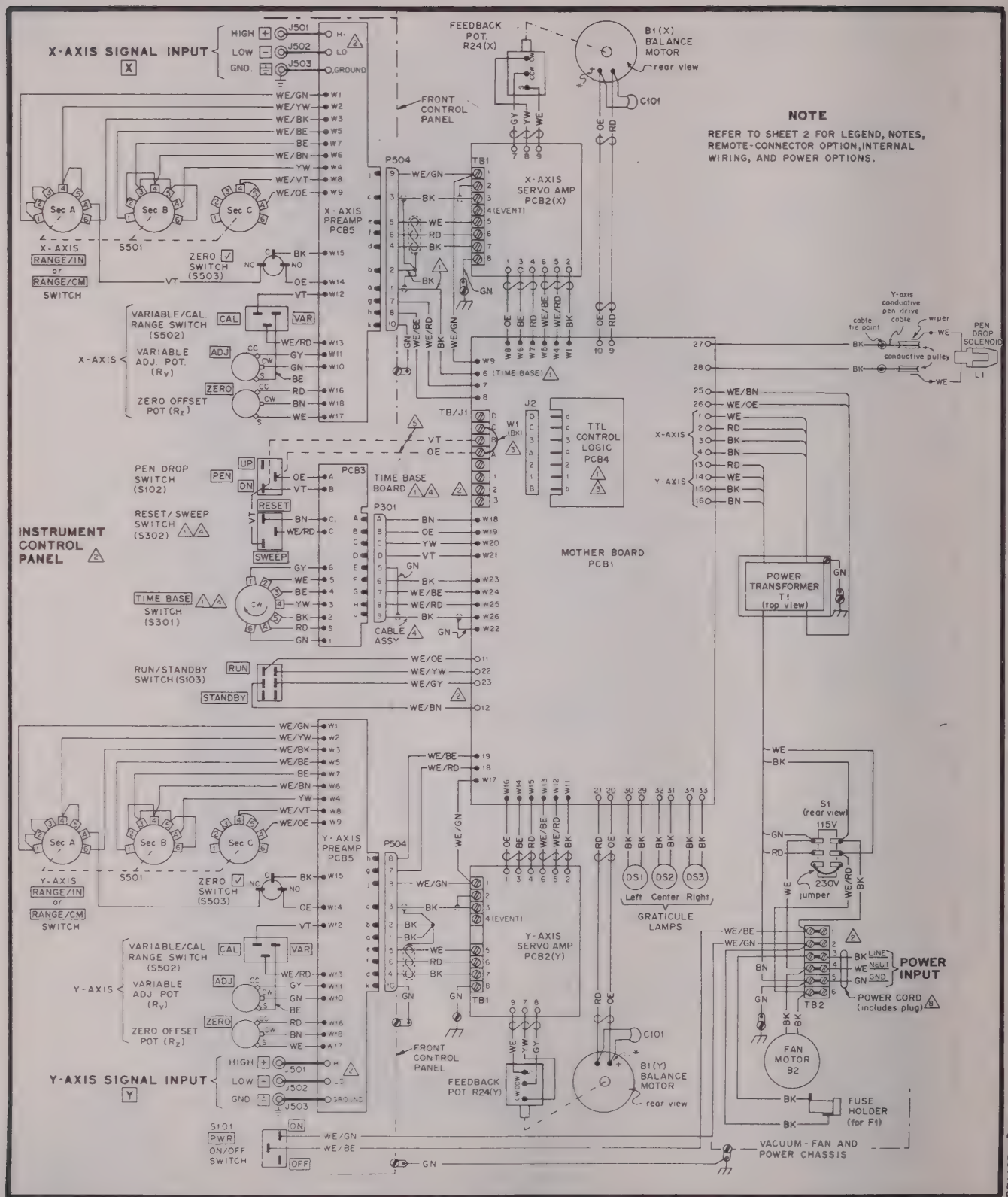

Figure 6-6. Wiring Diagram for Model XY575-Lab Recorder (Sheet 1).

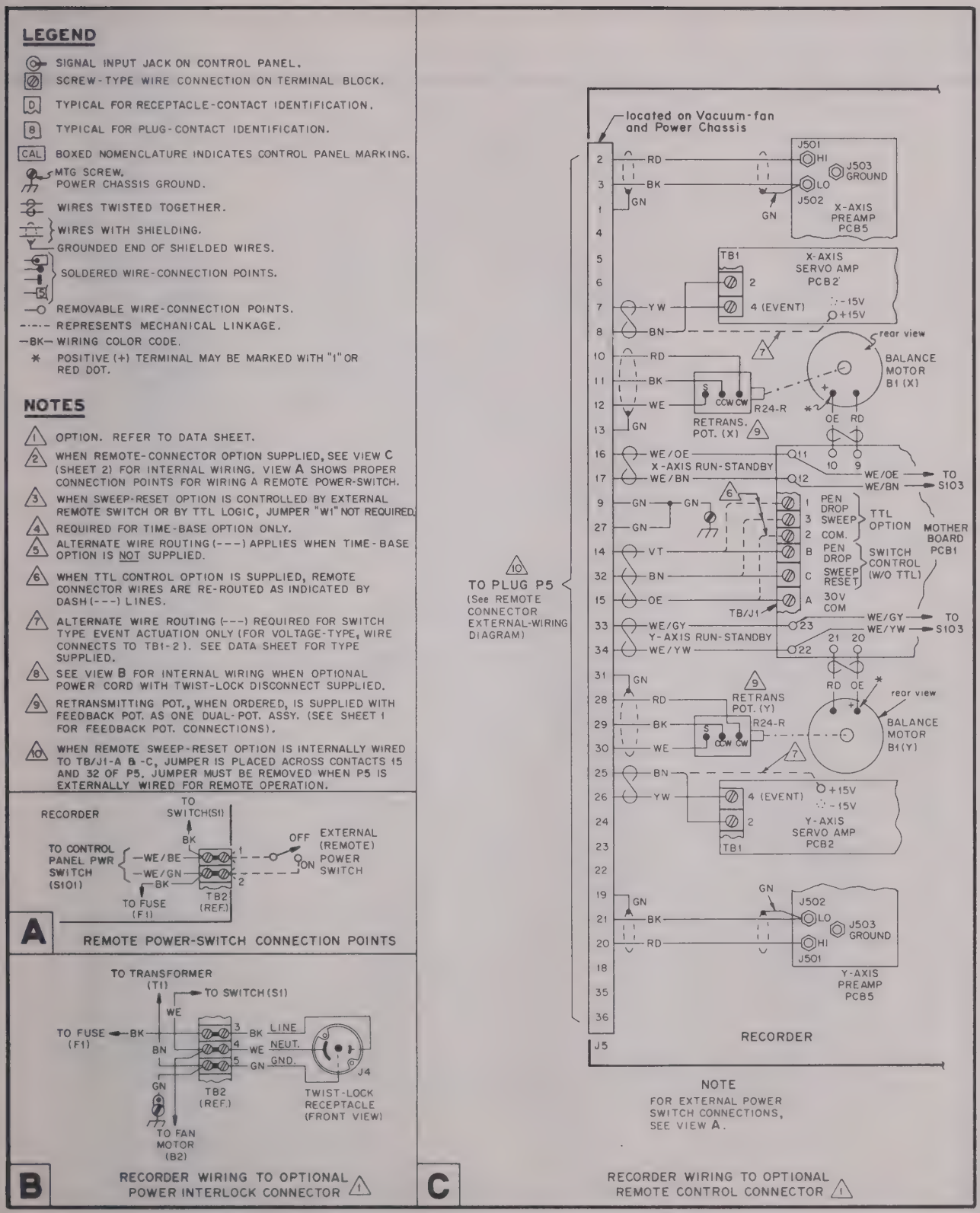

Figure 6-6. Wiring Diagram for Model XY575-Lab Recorder (Sheet 2).

Table 6-1. Control Panel Assembly.

Fig.6-7 Ref. No.	Part Number	Description	Qty.
--	733D7-†	Control Panel Assy. (Complete)	1
1	733D8	.Panel Assy. (Less Parts)	1
2	733C23-1	.Decal, Panel (Metric w/o Time Base)	1 A/R
2	733C23-2	.Decal, Panel (Metric w/Time Base)	1 A/R
2	733C23-3	.Decal, Panel (English w/o Time Base)	1 A/R
2	733C23-4	.Decal, Panel (English w/ Time Base)	1 A/R
S503	SWB11	.Switch, Pushbutton (Zero √)	2
R_Z,R_Y	POT85	.Potentiometer; 10K (Zero/Var. Range ADJ.)	4
S502	SWS4	.Switch, Slide (Range VAR/CAL) SPDT	2
S501	733A45	.Switch, Rotary Multirange (RANGE)	2
S101	51166	.Switch, Slide (POWER ON/OFF) SPST	1
S301*	733A46	.Switch, Rotary Multirate (Time Base)	1 A/R
3	DAL19	.Knob, Control	1 A/R
S102	51166	.Switch, Slide (PEN UP/DOWN) SPST	1
S302	51166¶	.Switch, Slide (RESET/SWEEP) SPST	1 A/R
S103	SWS1	.Switch, Slide (RUN/STANDBY) DPDT	1
4	ND40210-5	.Screw, Switch Mtg. (4-40 x 1/4 Flat Head)	10 or 12*
5	ND40122-6	.Nut, Hex Mtg. (4-36)	8 or 10*
6	SP1904	.Washer, Lock (No. 4)	8 or 10*
PCB3*	(See Table 6-2)	.Time Base PC Board Assy.	1 A/R
7	ND40210-10	.Screw, Mtg. (6-32 x 1/4 Flat Head)	6
8*	NX90605	.Screw, Mtg. (6-32 x 5/16 Binding Head)	2
9	SP1906	.Washer, Lock (No. 6)	4 or 6*
J501,J502, J503	16805068-001	.Post, Jack (Signal Input)	6
10	16100495-102	.Cap, Post Insulating (Red)	2
11	16100495-103	.Cap, Post Insulating (White)	2
12	16100495-105	.Cap, Post Insulating (Blue)	2
13	16750409-028	.Nut, Hex Mtg. (1/4-32)	12
PCB5(X)	733B26-2	.PC Board Assy., Preamp (X-Axis)	1
PCB5(Y)	733B26-2	.PC Board Assy., Preamp (Y-Axis)	1
14	733B26-1	..PC Board (Less Parts)	2
C501	CMM39	..Capacitor, Molded Mylar; 0.1µF	1
C502	40763-3	..Capacitor, Disc; 50pF	1
IC501	OPA308A	..Op-Amp, IC (LM308AH)	1
R501,R504	RCC1-103	..Resistor, C.C.; 10K, ±5%, 1/2W	2
R502	40724-992	..Resistor, W.P.; 990K, ±0.1%, 1/4W	1
R503	RWP6P100000	..Resistor, W.P.; 10K, ±0.1%, 1/8W	1
R505	RWP27Q500000	..Resistor, W.P.; 5K, ±0.1%, 1/4W	1
R506	RWP2R806000	..Resistor, W.P.; 806Ω, 1%, 1/2W	1
R507	RCC1-822	..Resistor, C.C.; 8.2K, ±5%, 1/2W	1
R508	RCC1-272	..Resistor, C.C.; 2.7K, ±5%, 1/2W	1
R509	RWP6A495000	..Resistor, W.P.; 495K, ±0.1%, 1/8W	1
R510	RWP6P450000	..Resistor, W.P.; 45K, ±0.1%, 1/8W	1
15	733A35-1	.Spacer, Board Mounting (Upper)	4 or 6*
15A*	733A42-2	.Spacer, Board Mounting (Short)	2
16	733A42-1	.Spacer, Board Mounting (Lower)	4
17	16756585-004	.Washer, Zero √ Switch Mtg. (1/4" Dia.)	4
18	7021	.Washer, Spring	8
19	X1061	.Washer Plain	4

† Refer to instrument Data Sheet for specific assembly number supplied.
* Required for multirate Time Base option only.
¶ X-axis option when Time Base is used.

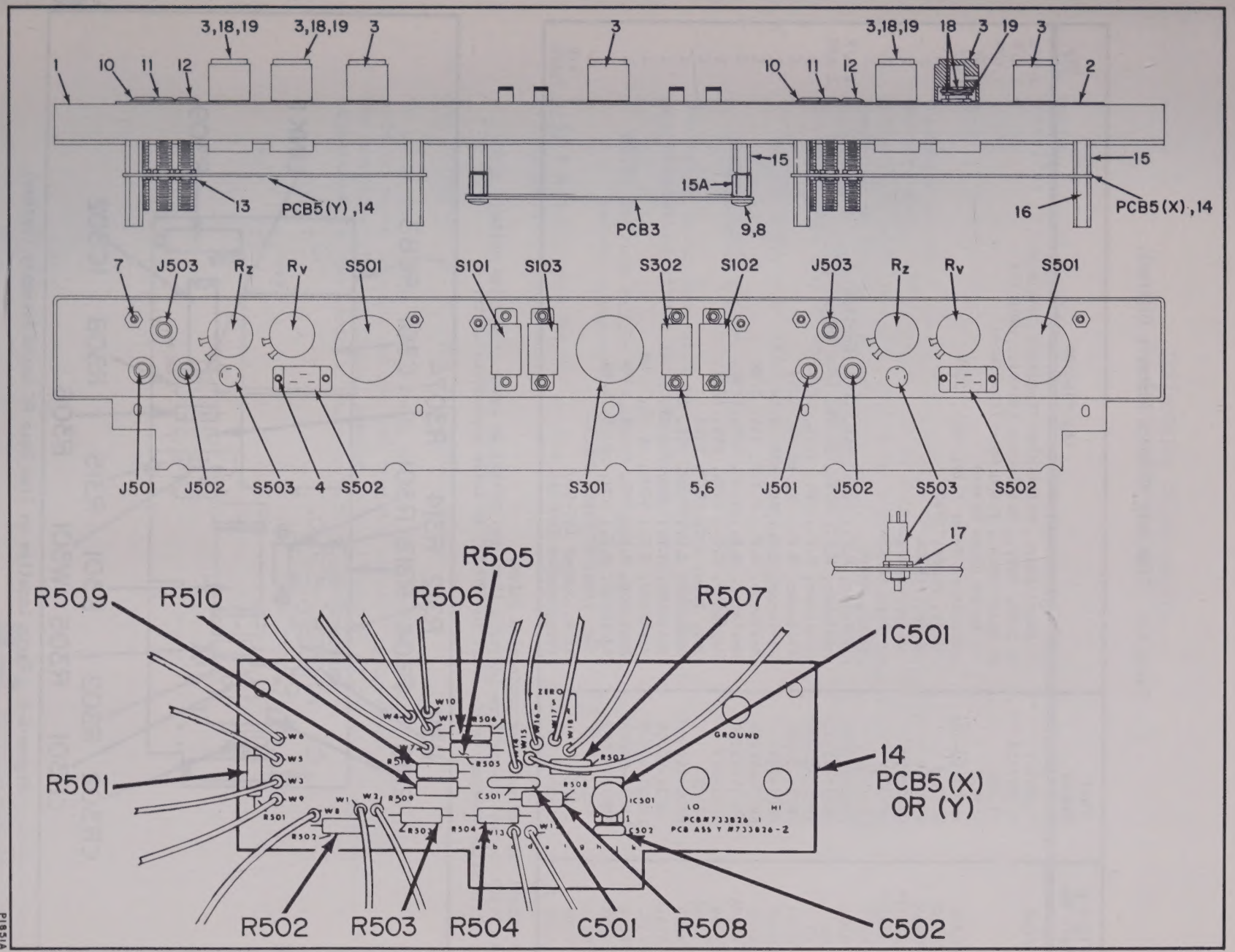

Figure 6-7. Control Module Assembly Parts Location.

Table 6-2. Time Base PC Board Assembly (Option).

Fig. 6-8 Ref. No.	Part Number	Description	Qty.
PCB3	733B20-1	PC Board Assy., Multi-Rate (English) Complete	1 A/R
	733B20-1M	PC Board Assy., Multi-Rate (Metric) Complete	1 A/R
	733B20	PC Board Assy., Fixed Rate (Complete)	1 A/R
1	733B21	.PC Board (Less Parts)	1
C301	16800058-001	.Capacitor, Mylar Film; 10µF, 200V	1
CR301	43125	.Diode, Zener; 1N823	1
CR302	43421	.Diode, 1N4004	1
IC301†	ICT2005	.Op-Amp; HA2-2005	1
IC302*	OPA307N	.Op-Amp; LM307N	1
K301	REL17	.Relay, Reset	1
R301	RMF34-50002	.Resistor, M.F.; 500K, ±1%, 1/4W (English)	1 A/R
R301	RMF10-62502	.Resistor, M.F.; 625K, ±0.5%, 1/4W (Metric)	1 A/R
R302	RMF21-10009	.Resistor, M.F.; 10Ω, 0.5%, 1/4W	1
R304	RMF21-10000	.Resistor, M.F.; 1K, ±0.5%, 1/4W	1
R305	RCC1-102	.Resistor, C.C.; 1K, ±5%, 1/2W	1
R306	RMF28-61900	.Resistor, M.F.; 6.19K, ±1%, 1/8W	1
R307A	RMF34-11000	.Resistor, M.F.; 1.1K, ±1%, 1/4W	1
R308	RCC1-221	.Resistor, C.C.; 220Ω, ±5%, 1/2W	1
R309Δ	PPC11	.Pot, Trim; 100K (RATE BAL)	1
R310	RCC4-751	.Resistor, C.C.; 750Ω, ±5%, 1W	1
R311	RMF21-50008	.Resistor, M.F.; 500Ω, ±0.5%, 1/4W	1
R312	RMF21-40008	.Resistor, M.F.; 400Ω, ±0.5%, 1/4W	1
R313	RMF21-50009	.Resistor, M.F.; 50Ω, ±0.5%, 1/4W	1
R314	RMF21-40009	.Resistor, M.F.; 40Ω, ±0.5%, 1/4W	1
R315	PPC7	.Pot, Trim; 1K (RATE CAL.)	1
W301	01066	.Wire, Jumper (22-GA)	A/R
LINK 1	0512	.Wire, Jumper (24-GA)	A/R

† IC301 deleted in later production units.
* IC302 becomes op-amp Type LH0042CD (Part No. OPA42) in later production units.
Δ R309 value changed to 10K (Part No. PPC12) in later production units.

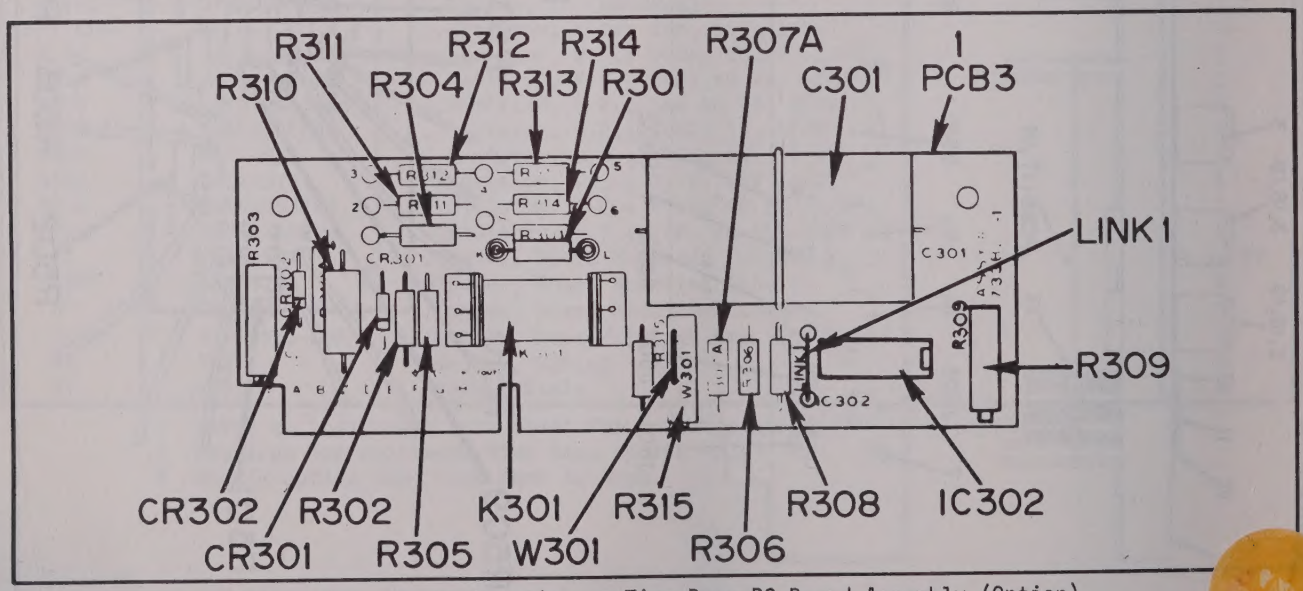

Figure 6-8. Parts Location on Time Base PC Board Assembly (Option).

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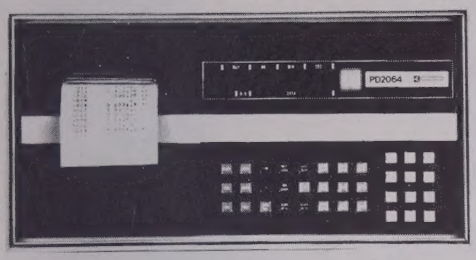
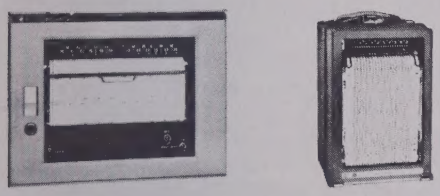
Instruments for — Data Acquisition, Analysis, Recording, and Controlling

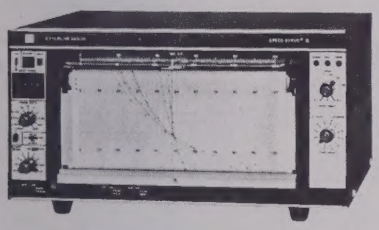


Key-Programmable Data System (PD-2064): Gathers analog and digital data in the field, lab, and plant on up to 248 channels, pushbutton-controlled through an 11-function keyboard and microprocessor setup. Signal conditioning, crystal controlled clocking, measurement as fast as 25 channels/second, optional high/low alarms, two outputs plus LED display, and integration.

Count/Time Systems: Models DE2100 and DE2101 gather production, research, and traffic study data on up to 248 channels. On each channel they record number of switch operations or totalize On-time duration with printed tape and computer-compatible outputs listing performance by channel for the last minute, hour, 8 hours, or month.

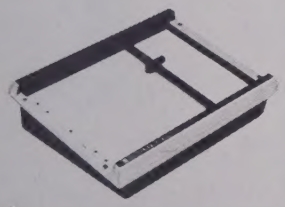


Direct writing recorders: Widest range of direct writing instruments—from 4½″ single channel curvilinear to four 2$\frac{3}{16}$″ channel Rectigraph recorders. Electrodynamometer or permanent magnet moving coil types. To record (generally) mA, A, V, W, Vars, KVA, frequency, pressure, vacuum, speed, position. Electric or spring drives with hr., min., and sec. chart speeds. **Event recorders too.**

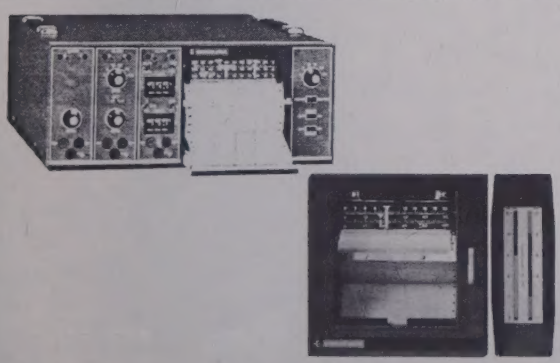


Speed Servo® II recorders: Single pen, two-pen crossover, two-pen side-by-side. 0.3 sec. response, 10″ recorder. All feature linear servo motor, wireless feedback potentiometer, and 2, 5, or 10 chart-speed drives.

Ink or inkless multipoint: Inkless multipoint recorder thermally brands analog data on up to 24 channels at 1 second print rate on 10″ heat-sensitive chart. Universal input panel accepts millivolt/volt or thermocouple inputs. Alarms. Bench, rack mount or panel mount styles.



X-Y recorders for every need: Model 530 is for general lab use, with a sensitivity of 1 mV/in to 10 V/in. Model 540 is a two-pen crossover ideal for analytical readout, plotting dependent vs. independent voltages, or statistical plotting. Model 575 is stripped down for OEM applications, or order with add-on multirange module. Slew speed 45 ips both axes. Pen drop repeat rate of 45 cycles/sec.



Miniservo® III recorders for lab or industry: 1, 2 or 3 pens per servo recorder with independent amplifier per channel. Lab model features flexible building block concept with a selection of five interchangeable plug-in amplifiers from 1MVDC, AZAS and four chart drives. Bench case, 10 cm chart width. Industrial Miniservo III has built-in transmitter loop power supply ideal for process industry. Seismic approved. 7″ x 7″ panel mounted.

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Rev. 0480

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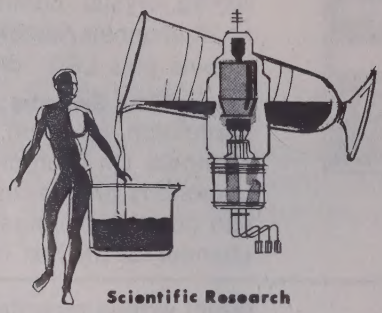
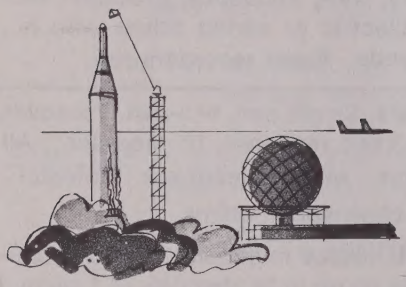
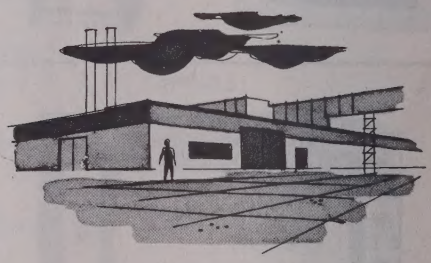
INSTRUMENTS for Data Acquisition, Analysis, Recording and Controlling



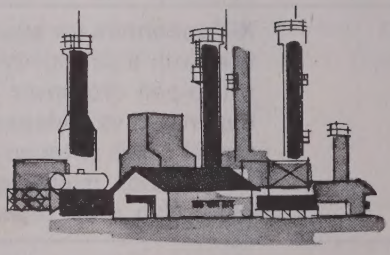
Scientific Research



Space Exploration



Production Analysis



Process Monitoring and Control

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